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ON METEORITES.[1]

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WE know that in the organic world, besides the larger animals and plants, there exist immense numbers of living beings of diminutive size, from those barely visible to the unaided eye down to those which can only be discerned in powerful microscopes, and of which many thousands live in a space no larger than a drop of water. Similar is the case with the heavenly orbs revolving in the infinite space. Besides the big luminaries, numerous swarms of very small bodies are hurrying through the space in their different varying orbits. To the smallest of these—the so-called meteorites—I here wish to call your attention. There is a circumstance which imparts them with a special interest to us; for they sometimes fall to the earth, so that we are able to lay hold of them, touch them with our hands, study them chemically and microscopically—in short, examine them by all the means available to us for a scientific investigation of their nature. The meteorites thus form a kind of connecting link between astronomy and mineralogy—sciences otherwise rather distant, but which in this instance are brought to mutually throw light upon each other.

It is probable that, on an average, several meteorites reach the earth every day, but many falls occur at night, while others drop into the sea, are lost in deserts or in places inhabited by ignorant people. In going over the falls of meteorites which have come to our knowledge, it appears that no more than four or five cases a

[1] A lecture delivered at the University of Christiania, Norway.

year, on an average, are recorded; and in but comparatively few instances the fallen stones are hunted up by people in order that they may become of use to science. The meteorites, therefore, owing to their variety, rank among the most precious treasures of the mineralogical museums. To illustrate the value generally attached to them, it may be mentioned that after it had become known that the meteorite found last year at Tysnæs, Western Norway, had been acquired by the Christiania Museum, a mineralogist was dispatched by the Riks-museum, in Stockholm, Sweden, the long way across the Scandinavian Peninsula, in the hope that he might be able to pick up some fragments.

A chief object of this paper is, therefore, to call the attention of the public to the meteorites, in order to prevent possible falls from being passed unheeded. The attention once aroused, it may also be possible to ferret out meteorites, the fall of which, in former times, has been kept a secret, owing to the superstition that, reduced to a powder, they might serve as a medicine for man and beast. In Norway, for instance, they were known as "thorelo"—*i.e.*, "lo," or wadding of Thor, or thunder—the belief being that they fell during thunderstorms. Not all the stones which have been preserved as "thorelo," however, are meteorites by any means, many of them being only common pebbles, pieces of pyrites, or some other kind of mineral.

After these preliminary remarks, I shall proceed to the special subject of this paper—the meteorites and their nature—to be treated of in three separate sections, viz.:—

(1) The phenomena accompanying the fall of meteorites; (2) Their mineralogical nature, and (3) Their position as celestial bodies.

The circumstances under which the fall of meteorites occur being rather similar in most instances, we may take, for an example, the fall of the Tysnæs meteorite. It occurred on the 20th of May, 1886, near the farm called Midt Vaage, situated on the Island of Tysnæs, south of Bergen, Norway. Between eight and nine o'clock in the evening the inhabitants in a wide circle of surrounding country were frightened by a loud report, which most of them took for a clap of thunder, the stone falling down immediately after the report. I have myself examined two grown-up persons who witnessed the meteorite coming down from the air. One was a woman working in a potato-field. She heard a loud noise, and,

looking up into the sky, observed a black mass of clouds, from which she thought she heard a cracking sound, repeated five or six times, upon which the stone fell with a whizzing and rumbling noise a little distance off. Dust arose from the spot where it struck the ground. The woman walked up to where it fell and saw a hole in the ground, but found nothing else, as the meteorite had bounded off several yards from where it first struck. The other eye-witness —a man who was a little further off—was just going home after having finished his day's work. He heard the report, and shortly after saw the stone coming down, "like a shot bird." No fiery display was noticed at the place; but people who witnessed the phenomenon from a distance of several miles (a Norwegian mile about equals seven English miles)—as, for instance, in Bergen and in Vossevangen—observed a fire-ball darting with great speed across the sky and then exploding in the direction of Tysnæs. Comparing the accounts of the direction of the fire-ball by the different observers, it appears that the meteor must have moved nearly vertically towards the earth's surface. That the fire-ball escaped the notice of those on the spot may be accounted for by its being right above their heads, as one seldom notices what occurs right over one's head. Their attention was first attracted by the report; but as this, of course, was heard a considerable time after the explosion of the fire-ball, the fiery display had ceased long before the thundering noise could reach them, after which some time again elapsed before the stone fell. The man pointed out to me the corner of the field where he was standing at the time he heard the report; when the stone fell he had nearly reached his house. In ascertaining the distance, he found that it took him about one minute and ten seconds to walk from one place to the other. Judging from the space of time which elapsed between the report and the fall, the explosion must have taken place at a very great height above the surface of the earth. With due regard to the traveling speed of the sound and the probable celerity of the fall, the height may be estimated at twenty to thirty thousand metres; but any certainty cannot be arrived at.

The next morning a girl living close by found a big, black stone lying in the grass. She put it aside, but did not mind it any further; and people's attention was not called to it before it was rumored that a stone had been seen falling from heaven. The following Sunday the curious stone formed the main topic of

conversation among the people assembled at church. An emigrant Norwegian, on a visit home from America and about to return to this country, made a bargain with the poor woman on whose land the stone was found: he was to take it away for a mere song; and the Tysnæs meteorite came thus very near going to America. On coming home, however, the woman became uneasy at the idea of selling such a God-send—direct from heaven—and she returned the money. Shortly after, the district physician, Mr. Gjestland, heard of the stone, and, realizing its great scientific value, he at once took it into his charge. It is owing to this gentleman's most obliging intervention that the stone—against a handsome remuneration, of course—was secured for the University of Christiania. This meteorite weighs about forty pounds. Several smaller fragments were also found.

The phenomena mentioned above—viz.: a fire-ball rushing along and exploding with a thunder-like report, followed by the coming down of the fragments—are those regularly observed accompanying the fall of meteorites. In some cases the velocity of the fire-ball has been ascertained to be sixty to seventy kilometres a second. This tremendous velocity accounts for the fire phenomenon, as the atmosphere, not being able to escape before the missile, becomes condensed to an enormous degree—a great quantity of heat thus being developed, according to the known physical laws. The meteorites, at one time having the temperature of space through which they were rushing—a temperature far below the freezing point—will thus become enormously heated on the outside when entering the earth's atmosphere. The pressure of the strongly-condensed atmosphere, finally exceeding a certain limit, acts as a blasting-agency, according to a commonly-accepted opinion, and the fire-ball explodes. The fragments are still glowing for a while after the explosion, but, as a rule, they have probably become cooled off when reaching the ground. Nor is the final speed very considerable, the original velocity of the fire-ball having been diminished by the resistance of the air.

When falling at full speed, the surface of the meteorites may be supposed to be continually melting—nay, perhaps, evaporating. By the friction of the air, however, the molten substance is removed almost as fast as it is formed. In this way the "fire-tail"—which the observers in many cases affirm having seen—may be explained. In the same manner the "smoke" is formed which, on several occa-

sions, has been observed floating in the wake of the fire-ball, after the latter has disappeared. Several people assert that such a smoke was also seen accompanying the Tysnæs meteorite. The fallen

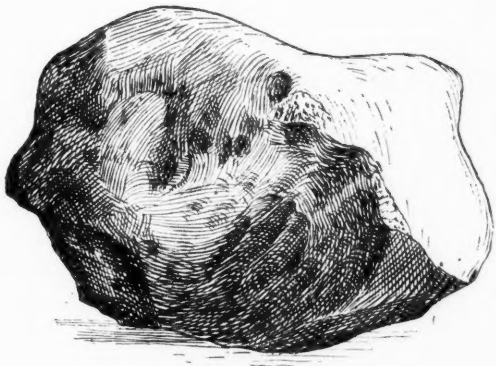


FIG. 1. The Tysnæs Meteorite.

stones show various signs of intense heating in the atmosphere, to which we want to direct the attention. In some cases, when stones have been taken up shortly after striking the ground, they have still been warm. In one instance it has been related that the fallen stone was at first so hot as to burn the fingers, and afterwards turned so cold that it could not be held in the hand for that reason. This may be regarded as very probable, when we consider that the heating in the atmosphere only lasts a few seconds, and that its action, consequently, must be quite superficial. Space, on the other hand, has an exceedingly low temperature, and the freezing coldness of the interior of the stone will therefore soon lower the temperature of the surface.

The interior of the meteoric stones, as a rule, is gray or whitish; the exterior, on the contrary, is covered with a blackish crust, which, on examination, proves to be the stony substance, having undergone a melting process. It is difficult to tell what shape the meteorites have before entering our atmosphere, as we only gather bits and fragments after the explosion. These show the effect of the compressed and intensely-heated air. The edges of the fragments, originally sharp, have become rounded, and on the surface there appear deepened marks, many of which look as if the stone had

once been soft as a dough in which the kneading-fingers had left their impressions. The air has had a consuming effect on the stone —much in the same way as a powerful jet of sand acts on a solid body. Mr. Daubrée has experimentally imitated this remarkable effect of the air. Not being able to move a solid against an aëriform body with sufficient speed—as is the case with the meteorites —he chose to proceed in the opposite way, making air strike solid bodies with great vehemence by exploding dynamite cartridges against an iron rail. The result of the experiment showed that the gases, suddenly developed by the dynamite exploding, produced hollows even in a body of such resisting-power as an iron rail, and the form of the impressions—in this as well as in his other experiments—corresponds exactly to those found in the meteorites.

Having now considered the phenomena accompanying the fall of meteorites, we shall now direct our attention to their *mineralogical nature.*

The meteorites may be classed in two primary groups: stone-meteorites—to which belongs the Tysnæs meteorite—and iron-meteorites, which consist chiefly of this metal. The two principal minerals composing the stone-meteorites are *eustatite* and *olivine* (or *chrysolite*)—both of which are also found on our globe, though rather rare—besides which these meteorites also contain grains of native iron, as an occasional sprinkling, through the mass. Examined by the microscope, they exhibit a structure which proves that originally and before entering the atmosphere they were formed out of melted masses by congelation. Fouqué and Michel Lévy have produced, artificially, the structures mentioned by melting together suitable substances. It thus appears that these small heavenly bodies, in precisely the same manner as the crust of our own globe, consist of originally molten masses, having afterwards become solidified. In this connection, it may not be out of place to remind one of the fact that the interior of the earth consists of substances heavier than those most commonly found on the surface. The meteorite is also heavier than common stone; and it has been conjectured (with several reasons to support this hypothesis) that the interior of the earth consists of a substance similar to that composing the meteorites.

On further examining the meteorites, it is found that after having passed through the original congealing process they have undergone several changes on their way through space. In many cases it is

evident that their substance has been broken into small pieces, which again have become cemented together—a structure seen with uncommon distinctness in the Tysnæs meteorite, as represented in the accompanying cut (Fig. 2). Not all the fragments are so large as to be seen by the unaided eye; for in examining the stone by the microscope some very small ones are also found, mostly of a round or globular form. This breaking up and putting together again seems in the case of the Tysnæs meteorite to have occurred at least twice.

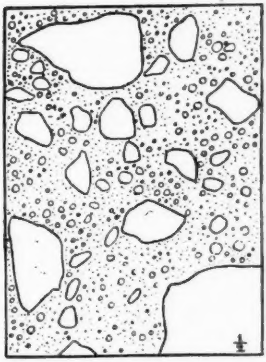


FIG. 2. Braccious structure of the Tysnæs meteorite. Drawn by the author.

The large fragments seen in Fig. 2 are composed of smaller ones, it being a case similar to a conglomerate in which the individual roll-stones consist of conglomerate. Fig. 3 shows a portion of the Tysnæs meteorite viewed in the microscope; while Fig. 4 represents an isolated globule of olivine, greatly magnified. It contains a brownish and glassy substance, in form reminding one of the cells of plants. Similar formations, not rare in meteorites, have furnished a fanciful scientist an excuse for obstinately asserting that they actually are the remains of plants. It is to be regretted that such is not the case; for it would undoubtedly have been interesting if in this way we had been able to lay hand on specimens of organic life from other globes.

The second group of meteorites consist of native iron—as mentioned above—with an occasional sprinkling of grains of stony minerals. Native iron occurs but rarely on this globe, as iron readily enters into combination with oxygen—in other words, it oxidizes, or rusts. In fact, it is so rare in nature, except in the meteorites, that any lump of iron produced by man was formerly believed to have fallen down from heaven. This was also Nordenskiöld's impression when, some years ago, he found quite a quantity of native iron in Greenland. The find was at that time much talked of; but Steenstrup afterwards pointed out that the supposed meteorites were only big lumps of iron which had weathered out of the rock on which they were found. This rock abounded to a remarkable degree in iron.

The iron of the meteorites, as a rule, contains more or less nickel irregularly distributed through the mass. If the polished surface of the meteoric iron be exposed to the action of some acid, there will appear peculiar linear designs, called the "Wiedmannstätten figures" (after the discoverer), the acid attacking the iron containing nickel to a less degree than the pure metal.

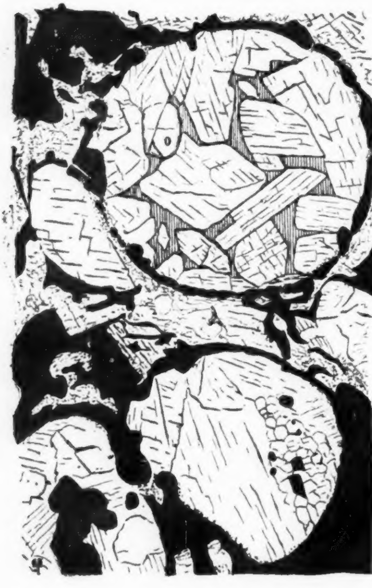


FIG. 3. Portion of the Tysnæs meteorite, magnified 65 times. Globules composed of enstatite crystals; the cementing substance in the upper globule is a brownish glass. o, grain of olivine Drawn by the author.

We will now direct our attention to our third subject, and consider the meteorites as celestial bodies.

Before entering into this, it will be necessary, however, to say a few words in regard to *shooting-stars* and *comets*, these being the celestial phenomena with which the meteorites are most nearly comparable.

To a common observer, who does not make a special study of the heavenly vault, it looks as if the shooting-stars move quite irregularly—now in this direction, now in another. If, however, their courses be carefully traced on an astronomical chart, it will be found that in most cases they radiate from certain points in the sky —a great many of which have already been ascertained. That the shooting-stars come from a certain point means that they are moving from that section of space towards the earth, the radiation being only the effect of the perspective as they move from the distance in the direction of the observer. The best-known swarm of shooting-stars is undoubtedly the one which appears to radiate from the constellation of the Lion, and is passed by the earth on the 13th of November. As on this day extremely numerous falls of stars have been observed, with a regular interval of thirty-three years, it is

evident that they belong to a swarm which, after a revolution of thirty-three years around the sun, returns to the orbit of our globe.

The comets are apparently something entirely different from the shooting-stars; for while the latter are quite small and only appear within the terrestrial atmosphere, the comets are bodies of immensely greater size, comparatively speaking, and moving at a very great distance from our little planet. Investigation shows, however, that the orbits of both comets and shooting-stars have the same form, they being elongated conic sections: hence their approaching from distant dark regions of space—now close to the sun, now again retiring to an immense distance from it. In regard to one comet, it has, furthermore, been ascertained that it moves in the same orbit as the swarm of shooting-stars mentioned above. The exact nature of the comets has not yet been made out with any certainty, the best-supported hypothesis being that they consist of immense quantities of small solid bodies. The comets nearest to the sun, when tn their greatest proximity to that body, are exposed to an enormous heat, soon followed, as they retire, by a cooling off equally enormous. The strong influence of the sun's vicinity on the comets shows itself, among other things, in the well-known long tail, which they project on the further side from the sun, and the nature and origin of which is still rather mysterious. Neither is the true nature of the shooting-stars fully ascertained. Many of them, however, appear to be small solid bodies rushing through the air; and there are a great many intermediate forms between the common shooting-stars and the big fire-balls which explode with a thunder-like report and emit meteoric stones.[1]

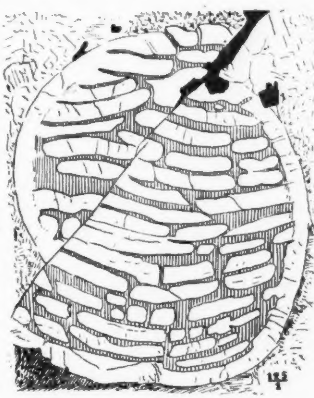


FIG. 4. Globule of ollvine, divided by a fault. Magnified 125 times. Drawn by the author.

[1] Mr. Sophus Tromholt, the author of the beautiful work, *Under the Rays of Aurora Borealis*, has sent me the following interesting record of a shooting-star:—

"One starlight but moonless Saturday night during November or

In the meteorites we have, as seen, at last something palpable which we are able to study. It will therefore be of great interest to have their connection with the shooting-stars and comets more definitely established. The study of the orbits of the meteorites, however, is rendered much more difficult than that of the shooting-stars by their comparatively much rarer and more unexpected occurrence, by the terrifying phenomena often accompanying them, and by the fact that they are seldom observed by others than ignorant people. The mode of studying the orbits of the meteorites must, therefore, be different from that suited to the case of the shooting-stars.

Having made a special study of the dates of the recorded falls of meteorites, I have come to the conclusion that they, or at least some of them, may be referred to certain systems like the shooting-stars, and that in some cases periods—suggesting a connection with a certain group of comets—may be set down with some probability.

The orbit of the earth around the sun may be considered as divided into three hundred and sixty-five parts, one of which is traversed on each day of the year. That the fall of a meteorite occurs on a certain date means, then, that the part of the earth's

December, 1883, between eight and nine o'clock, as Mr. Lionæs, a bookseller in Fredrikstad, Norway, was standing in his yard looking incidentally up into the sky, he observed a shooting-star in the north, at a height of about 60°, moving in a curve and gradually increasing a little in size. The exact length of time he is unable to state: he had turned his eyes away, when suddenly a small, shining body fell down before his feet, not two yards off, passing him so closely that in his fright he sprang aside. When the meteor struck the ground sparks flew in all directions, and a faint report was heard. This noise was also heard by his daughter, who at the time was in the passage leading to the yard. Shortly after—'about a minute'—both father and daughter observed a similar meteor in the same direction, which seemed to descend behind a neighboring house.

"The gentleman mentioned is uncertain as to the exact date of the observation; but the choice seems to lie between the Saturdays, November 3d, November 23d, and December 1st; but as, according to the meteorological observations recorded at the Fredrikstad Station, the sky was overcast on the two former Saturdays, the fall must have taken place on December 1st, when the weather was rather clear. He has stated to me that the size of the shining body was comparable to that of a walnut, and the little fragments into which it was broken when striking the ground he compared to small beads. Unfortunately, he omitted to collect them, and later search was unavailing, as the yard had been swept several times afterwards."

orbit designated by this date is intersected by the orbit of the meteorite. It now often happens that the earth is struck by meteorites on the same date during two or several consecutive years. This can only be explained by the earth on that date passing through a swarm of meteorites, or, rather, through a long stream taking several years in passing—if we consider that, on an average, no more than four falls of meteorites are recorded yearly. Thus, the earth was hit four times by meteorites on the 13th of December, between the years 1795 and 1813.[1] Since then the earth has not collided with any meteorites on that date.

Still more remarkable than dates which, like the above, show the meteorites to go in flocks, are others from which, with a considerable degree of probability, we may infer a certain period. Thus, the 13th of October is a date worth mentioning, as on that day falls of meteorites occurred in 1787, 1819, 1838, 1852 and 1872. On examining the differences between these years, they will be found to be very nearly multiples of $6\frac{1}{2}$—viz.: $5x6\frac{1}{2}$, $3x6\frac{1}{2}$ and $2x6\frac{1}{2}$. These falls, consequently, seem to belong to the same flock, with a period of between six and seven years. The flock must be rather lengthened and takes a considerable time to pass, since the earth passes it so often, as is recorded in this case. If the stream be short, there is, of course, very little change of the earth being just in the point in which the orbits of the earth and the meteorites cross each other every time the stream is passing. This would only be the case if the period were exactly one or more whole years. As this, of course, occurs but very seldom, it is not to be expected that the differences between the years be exactly multiples of the periods.

It may be well to quote other similar periods of meteorites. In February, two series of falls are particularly notable, viz.:—

February 19, 1785, at Witmess.	February 19, 1796, at Tasquinha.
" 18, 1815, at Duralla.	" 18, 1824, at Irkutsk.
" 16, 1876, at Indesgherry.	" 16, 1883, at Alfianella.

The possibility here suggests itself that the earth on February 19, 1785, met a flock of meteorites which, with a period of about thirty years, reappeared in 1815. No fall is on record from the next meeting. From the one then to follow, however—that is, from the one to take place sixty-one years from 1815—viz., in 1876, a fall is recorded. It will be observed that the dates are receding,

[1] To these falls may be added a fifth, which occurred on the Western Hemisphere, December 14, 1807.

as the first fell on the 19th; the second, on the 18th. The third fall, if it took place, probably occurred on the 17th; while the fourth happened on the 16th. This regular receding of the dates may be explained without difficulty as due to the precession retrograding comparatively fast. The case of the three falls of the second column may be the same, though their period must be shorter, the difference between 1796 and 1824 being 28, and that between 1824 and 1883 being 59.

We give below a list of other systems, in regard to which we remark that the figures in parentheses indicate the differences between the contiguous years:—

Period — Between six and seven years.	May 9—Drake Creek	1827	
	" 8—Monte Milone	1846	—(19)
	" 8—Dyalpur	1872	—(26)
	" 10—Estherville	1879	—(7)

Period — Between six and seven years.	May 11—Oesel " 12—Bremewoerde	1855	
	" 13—Butsura " 14—Canelles	1861	—(6)
	" 12—Kursk " 14—Nash County	1874	—(13)

This latter system is perhaps a double one, as in the same year two falls occur at an interval of a day.

Period—Between six and seven years.	March 15—St. Étienne de Lolm and Valence	1806	
	" 14—Cutro	1813	— (7)
	" 15—Lugano	1826	—(13)
	" 16—Rutlam	1863	—(37)
	" 14—Middlesborough	1881	—(18)

Period—About six years.	August 10—Slobodka	1818	
	" 10—Iwan	1841	—(23)
	" 11—Bentham	1859	—(18)
	" 12—Dundrum	1865	—(6)

Period—About seven years.	July 3—Mixburg	1725	
	" 3—Plan	1753	—(28)
	" 4—East Norton	1803	—(50)
	" 4—Crawford	1859	—(56)

Period—Eight years.	June 26—Dogowola	1864	
	" 28—Tennasilm	1872	—(8)
	" 30—Nogoya	1880	—(8)

Period— Eight years.	September 5—Agen	1814	—(40)
	" 5—Fehrbellin	1854	—(24)
	" 5—Dandapur	1878	

Period— Nine years.	September 10—Limerick	1813	—(9)
	" 10—Carlstadt	1822	—(9)
	" 9—Wessely	1831	

In November there are several falls, suggesting periods of ten years, viz.:—

November 5—Bourbon, Vendée	1841	—(10)
" 5—Nulles	1851	
November 11—Lowell	1846	—(10)
" 12—Trenzano	1856	
November 29—Cocenza	1820	—(30)
" 30—Shalka	1850	
November 30—Futtehpore	1822	—(20)
" 30—Myhee Caunta	1842	

In the following series the five last observations correspond to a period of about twelve years:—

May 19—Novgorod	1421	-(131)
" 19—Schleussingen	1552	-(146)
" 18—Walringen	1698	-(108)
" 17—Hampshire	1806	-(24)
" 17—Perth	1830	-(25)
" 17—Igast	1855	

The oldest date is uncertain, 131 being one less than 11x12. Suppose the period being only one-half as long as indicated above, still another date might be added—viz.: May 18, 1860, on which day a fall occurred at London.

In the following system, which has a period of about twenty-three years, the dates are receding:—

August 6—Dortrecht	1650	-(162)
" 5—Chantonnay	1812	-(23)
" 4—Cirencester	1835	-(47)
" 2—Pawlowka	1882	

As a result, then, several flocks of meteorites can be pointed out, which have a certain period, the latter being, in most cases, between six and eight years. It is noteworthy, in this connection, that the

period of most of the comets, the return of which have been observed, is five or six years. The study of the dates of the different falls, therefore, not only suggests that at least a part of the meteorites move in orbits round the sun, but also intimates a certain relation of some of them with a definite group of celestial bodies—viz.: the comets of short periods. We have thus established a new link connecting the meteorites with the comets in addition to those already known—viz.: the strong resemblance of the fire-balls to the shooting-stars, as well as the great velocity of several of the former, making it probable that they move in orbits of the same lengthened form as the comets. If called upon to define the nature of a meteorite, briefly and somewhat boldly, I should say, with Mr. Newton, the American: A meteorite is a bit of a comet.

Let me add a few remarks in regard to the question whether there is anything in the structure of the meteorites which goes to confirm the views here set forth. The orbits of the meteorites being similar to those of the comets, the consequence would be, as mentioned above, that during a comparatively short time, once in each period, when near the sun, they would be exposed to an enormous heat, succeeded by quite as enormous a cooling off in the cold parts of space. The fragmentary (chondrite) structure, so general in the stony meteorites, is perhaps to be explained in this way. On the earth the annual and daily heating and cooling produces, as we all well know, the weathering or general crumbling of the earth's crust, the formation of stones, gravel, sand and dust. There is a difference in regard to the meteorites, in so far as they are not covered with water or surrounded by an atmosphere, by which agencies the weathering of our earth is brought about; but, on the other hand, the difference between the heat and the cold, owing to this very want, and especially to the form of the orbit, must be enormously greater on the meteorites; for while the differences of temperature on the earth rarely rise to 50° C., the changes which take place on the meteorites must be estimated at 1,000° C., or more. It may not, then, be unreasonably supposed that the fragmentary structure so common in the stony meteorites is due to the changes of temperature they have undergone. How the fragments may have become rounded off by being ground against each other or in some other way, may easily be conceived, as there are plenty of instances in regard to comets, in which movements in their mass have been observed. Theoretically, the study of the Tysnæs mete-

orite is interesting, not only for the fact that it clearly shows the chondrite structure to be of a fragmentary nature, but especially because it affords proof of the process having been repeated—a circumstance not at all surprising in a celestial body which, in its wanderings through space, has repeatedly approached close to the sun.

In addition to the above, it should also be remembered that the gases—carbonic acid, carbonic oxide and hydrogen—which have been successfully extracted from meteorites, are said to give the same spectroscopical lines as the comets when approaching the sun.

The above explanation of the different peculiarities in the structure of the meteorites is advanced here, of course, chiefly to instigate further investigation. As here propounded, it does away with all moments which may not be reasonably admitted in regard to the orbits of these celestial bodies, thus, for instance, making unnecessary any recourse to volcanic or other processes supposed to have taken place on distant globes once large, but long since exploded.

In support of this latter theory—viz.: that the meteorites have originally belonged to globes of considerable dimensions—it has been argued that the formation of so large crystals as are found in some iron meteorites can only have taken place on a celestial body of respectable size. The correctness of this inference may well be doubted. It is true that on our earth—which, in this connection, may be regarded a big globe—some minerals form large crystals during a slow growth; but it cannot be inferred from this fact that large crystals cannot appear on a very small one. The mere circumstance that in the latter the force of gravity is practically nil makes matters there stand quite differently from what they are on a great celestial body. It may be supposed that as the force of gravity plays only an insignificant part, those other forces which produce the arrangement of the molecules in the crystals are allowed to have their play much more freely than under other circumstances. The smallness of the meteoric masses may perhaps also account for their easy crumbling and the dislocation of the fragments. The minerals of the meteorites, which on our globe appear to belong to the comparatively heavy substances, may in a certain sense be said to weigh nothing as long as they form part of a celestial body perhaps not a yard in diameter.

Among other things, it may also be supposed that the electric forces called into activity by the violent changes of temperature

play a much greater rôle than we might be apt to imagine, judging from the processes which take place on our earth.

Finally, I may mention that in some meteorites there is found evidence of their having been exposed to an enormous heat after their original formation. Several meteorites—particularly one from Stælldal, Sweden, which I have examined myself—show traces of an inner melting which must have taken place somewhere in space before entering our atmosphere, and which has nothing to do with the ignition of their surface in the latter and the molten crust

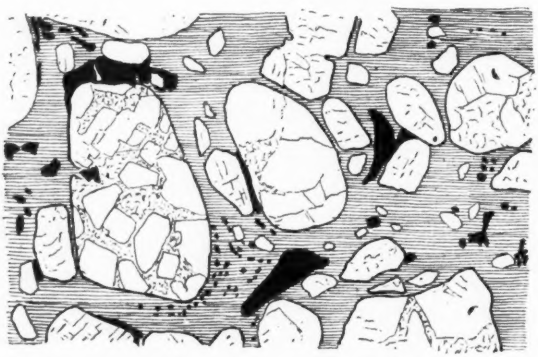


FIG. 5. The Stælldal meteorite viewed in microscope. $\frac{65}{1}$ Drawn by the author.

thus produced. The appended cut (Fig. 5) shows a portion of the Stælldal meteorite sixty-five times magnified. The black parts are iron; the light ones are pieces of unmolten substance swimming in a brownish glass, the chemical composition of which is like that of the unmolten substance. It will thus be seen that in the structure of some meteorites we have a direct proof of their orbits being of the same striking form as those of the comets, which alternately approach close to the sun and then again recede far from it.

THE GERM OF THE SOUTHERN CATTLE PLAGUE.

BY FRANK P. BILLINGS.[1]

IN order to prove that it is the manure of infected cattle which lodges the germs of Southern Cattle Plague, we must first find the germs.

Has anybody found them? To which I answer that there has, and that the honor belongs entirely to Nebraska, as well as does that of completely connecting the germ of swine plague with that disease, and discovering the true nature of that pest. Detmers saw the germ of swine plague first, but it was left to us to prove its unquestioned connection with that disease. Our discovery of the germ was as original as if it had never been discovered, but in no way detracts from Dr. Detmers' credit as the first discoverer.

Detmers found a germ in the Southern Cattle Plague, but it was a large baccillus, and had no direct connection with the disease. Salmon found another coccus in this disease, also, but it was a double coccus, and had no relation to it. These observations will be considered in detail in our full report. How may we know that we have discovered the germ in any specific disease? In order to make such an assertion the following conditions must be fulfilled in every detail:—

First.—In the tissues of animals ill with a specific disease must, in each case examined, be found the same germ.

Second.—This germ must be cultivated, free from every other germ, in some of the artificial media.

Third.—It must be shown that the germ in question has pathogenetic (disease-producing) qualities, by inoculating animals and killing them thereby.

These three conditions have been fulfilled. The germ of Southern Cattle Plague has been found in the blood, the gall, the urine, the liver, spleen and kidneys of every diseased animal on which we have made an autopsy. These germs have been also cul-

[1] Director of the Patho-Biological Laboratory of the State University of Nebraska.

tivated in an absolutely pure form upon and in artificial media. Gophers, or ground squirrels, have been inoculated with such cultivations and died from the effects, and the same germ found in their blood and tissues, and in sections made from their organs. Cultivations from the same have been also made, invariably showing the same germ as that got from the cattle.

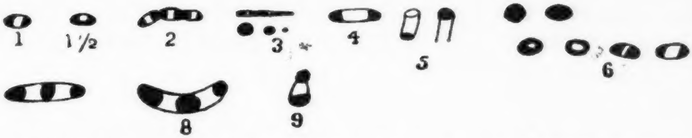
These results, however, do not show that this was the germ of Southern Cattle Plague. They only show that a germ was found in the tissues of Texas fever diseased animals that had fatal disease-producing properties.

How, then, can we tell that it is the specific germ of the Southern Cattle Plague?

To be able to affirm this fact positively cattle must be inoculated, as the ground squirrels were, with unquestionably pure cultivations, and the Southern Cattle Plague produced in those cattle, and the same germ found in their tissues and cultivated from them. We have done this, and can demonstrate the entire series of facts by cultures and microscopic specimens of the tissues.[1]

[1] Above I have stated the conditions which must be fulfilled in order to completely substantiate the discovery of a specific germ. I wish, however, to call attention to the discovery of another pathogenetic organism in which these conditions cannot at present be fulfilled and may never be so conclusively as we are enabled to do with germs of animal diseases. I allude to the germ of Yellow Fever, for which I claim not only the first discovery by an American, but for the only exact description of it. Babes saw it and partially described it, "Les Bacteries-Babes-Cornil," 1885, as follows :—

'The capillaries of the liver and kidneys contain great numbers of jointed filaments. With a Zeiss $\frac{1}{18}$ H. I., one sees these filaments to be made up of elliptoid-cylindrical granule united in pairs, or forming small clusters, in which *they are united by a pale intermediate substance.* The filaments are thus made up of diplococci or of very short segments," p. 448. In the "Comptes Rendus," Aug. 1887, p. 289, Lacerda attempts to describe an organism which he says is the same as that described by Babes, but his description is such a lamentable failure that no one would recognize the germ from it. In pieces of liver and kidneys from a case of "Undoubted Yellow Fever," sent me by Dr. Geo. M. Sternberg, I discovered the same organism described by Babes, and, no other being present, and the yellow fever a specific septicæmia, and this organism belonging to the same group, I make no hesitancy in affirming that it is the germ of the yellow fever, even though unable to fulfill all the necessary postulates of exact experimentation. On the other hand, the description of the germs of the Southern Cattle Plague and Swine Plague belonging to the same group, and an accurate knowledge of several others belonging to this species, warrants the assertion that this



MORPHO-BIOLOGICAL CHARACTERISTICS OF THE GERMS OF THE SOUTHERN CATTLE PLAGUE AND THE AMERICAN SWINE PLAGUE AND THEIR POINTS OF DIFFERENTIATION.[1]

These two micro-organisms are neither to be classed with Micrococci or Bacilli. They are not round objects like the former or rods like the latter. They belong to the intermediate group, to which the name "bacteria" has been given. Their longitudinal dimensions are about twice that of their transverse. They are ovoid. Their ends are rounded. If an endeavor be made to differentiate these germs from one another by a microscopic examination we shall find it impossible. They are approximately of the same size and shape. Fresh specimens of them both will not differ so much in dimensions as old cultures of either will from fresh ones, or different individuals in the same old cultures. They are description will answer in nearly every particular and every chief essential. The only points where a difference may be found will be these :—

1. The yellow-fever germ may cause gelatine to become fluid but probably not as no other of these germs does.
2. It may grow differently on potatoes and egg albumen.

In this regard attention will be called to the difference between the germs of the Southern Cattle Plague and Swine Plague when developed on potatoes. Now I have still another and hitherto unknown germ of this same group of which more will be heard later on.

On potatoes, the Swine-Plague germ grows a light gray-brown, coffee-colored ; the Cattle-Plague germ in yellow colonies becoming reddish, this new germ pure white.

On whites of eggs, the Swine-Plague germ grows in a semi-fluid almost pure white colony, difficult to see.

The Cattle-Plague germ develops in a delicate buff color with sharply circumscribed walls, while the new organism grows in deep yellow colonies with diffuse edges. However, I feel that aside from these points, the description herein given will answer completely for the germ of the yellow fever. Morphologically it cannot be distinguished surely from either of them.

[1] With the exception of the points to which attention has been called as to the germ of Yellow Fever.

about $\frac{1}{6}$ the transverse diameter of a red-blood cell, in length. In one way, however, they can be easily differentiated even by microscopic examination. *The swine-plague germ has a far sharper affinity (its poles) for the blue and violet tinctions than that of the Southern Cattle Plague, while the latter possesses a special affinity for Fuchsin, which the former does not.* Whatever the tinction used, if applied *lege artis*, the ends, poles, of these micro-organisms show a great specific affinity for the coloring material, *while the middle portion of their bodies has far less*, unless the exposure is pushed to a longer period, when this portion of the body will eventually color. The capsule of these germs seems to be composed of the same material as the ends, as it also colors in the same manner, thus presenting a delicate line of colored material, connecting the two colored, coccoid ends, or poles.

The most practical illustration which can be given of the microscopic appearance of these organisms, is to take a small white bean and paint both of its ends and two of its sides blue or red, leaving the middle portion unpainted. Looking down upon such a bean would give almost an exact picture of these germs.

Like the genuine and only germ of the American Swine Plague the micro-organism of the Southern Cattle Plague *is motile in fluid cultivating media when studied microscopically, as well as in the serum from the blood of diseased animals.*[1] The movements of the latter are, however, *less rapid or active* than those of the former organism.

In my earlier description of the micro-organism of the American Swine Plague, I called attention to the great morphological variations which it undergoes in its full cycle of development. These are its morpho-vegetative phenomena.

To one entirely unaccustomed to observing them, the first appearance of a cultivation of these germs—more especially an old one—would prove very puzzling. In fact, the novice would very often conclude that his cultures had become polluted by micrococci, so plentifully are these objects, apparently, represented. They simply represent a vegetative, embryonic, period in the development of this class of micro-organisms.

[1] For some, to me, unaccountable reason the German observers say the germ of the German Swine-Plague is not motile and Cornil says the same thing. *Now I positively assert the micro-organism of these two American diseases to be motile as well as a third one which I am not yet ready to describe.*

Hueppe has fallen into the serious error of endeavoring to classify these organisms by this vegetative morpho-condition. He calls them "Micrococci." To my mind it would be equally sensible and logical to call an ovum a man, or an apple seed an apple tree. It is far more practical for patho-biologists to stick to the name cocci for all round objects (not spores) which have equal diameters in their mature form and which color diffusely, and to call these ovoid organisms bacteria, where the longitudinal diameter does not more than over again exceed the transverse. As to bacilli, spirilli, etc., there need be no dispute, so plain are their morpho-characteristics.

The mature micro-organisms of the American Swine Plague and Southern Cattle Plague has been described above (Fig. 1) as resembling a white bean with the ends painted as well as its sides, leaving the middle portion of its body unpainted, as we look down upon it. Now that is the picture which the eye generally receives, but a more exact inspection of a stained covering glass specimen will show that the above is not always the appearance presented to the eye, even by the mature germ.

The above description depends upon the germ presenting itself to the eye in an exact horizontal position, that is, lying straight on its horizontal axis. If, however, it be turned a little one way or the other on its horizontal axis, numerous specimens will be seen where the white belt does not extend entirely across the object, as above described, but seems to be limited, more or less, to one side, and more of the colored substance will be seen on the opposite side than under general circumstances, or, perhaps better, in exact inspection (Fig. 1½). At first I mistook the appearance for the accumulation of the uncolored substance in this way during the process of its secretion from the colored ends, which I take to be the method by which this non-coloring material is produced. More mature reflection has shown me that the above explanation is partially or wholly incorrect. It has been mentioned that that portion of the capsule of these micro-organisms must have the same chemical composition as the pole ends, because it also colors somewhat under the same application of the tinction. Now why does it not show the same intensity of coloring? The only answer is: *that this capsule, being very thin, cannot take up as much color as the more dense pole ends; and being so thin, by the same amount of exposure, does not show any color when the middle of the object is looked directly*

down upon, but when the eye strikes the sides of the object, then we look through more material and, hence, see more color, just as when we look at a piece of window glass or a good glass slide. If we look directly through it, it is colorless, but if we turn it on edge and look at it, it has a more or less green shade, according to the quality of the glass. So according to the amount of exposure to the tinction, when not carried so far as to color the whole body of the germ, we have more or less visible coloring of the capsule, which can only be seen when we look through a considerable extent of substance, that is, on the sides of the object. Again, we may see two or three objects united together, all presenting the normal characteristics of full maturity. I have never yet seen more than three of these germs connected together (Fig. 2). In general they either appear singly or in pairs. In very old cultures these micro-organisms become thinner, more rod-like, and color more diffusely with the same degree of exposure to the tinction, and the white substance is either not visible at all or very faint (Fig. 3). Again, such old cultures are very replete in apparent micrococci, of various dimensions, which might lead one into the error of thinking that his cultures had become polluted. I call this last condition *that of coccoid degeneration* (Fig. 3). Or, we may see unusually long objects, the longitudinal diameter being twice or three times that of the mature organism, and the white, or uncolored, substance occupying a corresponding extensive amount of space, while the dark, or colored, ends may be somewhat larger or of the same size as those of the mature object. *This condition represents the first step in the development of these organisms, that is, they become longer, and more of this white substance appears* (Fig. 4).

The next step in the process of vegetative development is the separation of one of the pole or coccoid ends, which then becomes free, and for a moment is exactly round like a coccus, and, as in a hanging drop culture (to which I always add a very small amount of an aqueous coloring solution), one will naturally see a very large number of these coccoid objects on account of the fact that each individual present is continually going through the same process of multiplication. Here, again, one may see a condition or phenomenon that might be misleading.

One of the coccoid ends having been separated, the other may still remain connected with the white material, and as evidence that the colored ends have a greater degree of specific gravity, as well

as chemical composition, you will see, in the continual tumbling about, and turning over and over of their objects, *a white, round or nearly so, colorless object directly under the eye, or numbers of these objects.* When the germs in such a hanging drop culture have died from want of a sufficiency of nutrient material, you may see a large number of these objects, *which could be easily mistaken for spores:* but if we inoculate a new hanging drop culture from the same material used to prepare the former, it will be found impossible to fall into any such serious error, for it will be easily seen that these non-colored refracting points keep continually going out of sight, their place being taken by the coccoid non-refracting point still attached to the other end of the white substance, and by watching one and the same organism in its continual turning over, first one appearance and then the other will be presented to the eye until the second coccoid end has become detached (Fig. 5).[1]

What becomes of the uncolored transparent middle piece?

I do not know!

It appears, however, as if it underwent an almost immediate process of dissolution the moment it has become free from both of its polar attachments. That this substance does not represent a spore condition, or have any relation to spores, is to my mind entirely beyond all question, as I have searched most diligently for spores in old and fresh cultures, and others made at all kinds of temperatures, within the biological limits of these organisms.

In my first-published description of the micro-organism of the swine plague I gave an erroneous description of the manner in which the coccoid ends became freed from the white or connective substance. *This white, non-refracting, uncolorable material does not become extended to nothing, and then break in two, leaving the coccoid ends with a delicate, colorless flagellum, or spermatozoid tail, temporarily attached to one side,* as I then said, and as Detmers described it in 1880; *but the separation of these ends is direct, and by sharp segmentation. Were it otherwise we could not see the sporoid colorless ends of so many of these germs when freed from their appropriate pole ends.*

There are days when one cannot study them continuously at all. The best way to study hanging drop cultures, when one desires to spend several hours over them, is to first make some cover-glass

[1] Coloring such a specimen will at once show that no spores are present.

specimens of the same material, or take any other slides of an object of the same size and form, and observe such for about half an hour, thus preparing the eye to see what you want to see in the living developing organism. Unless this is done, some very essential points will be surely missed, and some preventable error fallen into. With anything less than a power of 800 diameters no one should attempt to study these organisms, and then only when aided by the best of Abbe condensers and oil immersion lenses.

We left our studies with the mature object proliferated into its first distinct stage of vegetative di erentiation. We had two coccoid objects before us, that is, two round objects, their diameters being the same in any direction. If colored, they color throughout, that is, diffusely.

Were these objects to remain in this condition, they would be, indeed, *Micrococci.* They do not, however. They almost immediately begin to increase in a longitudinal direction, but in this condition they still stain diffusely.

In my first description of the swine-plague germ, I said *that the next biological phenomenon was the appearance of a delicate white line, separating this ovoid object into two halves.* The above, while not exactly an erroneous description, is certainly anticipated by another phenomenon in the evolutional development of this coccoid, diffusely coloring object, into the mature form of any of this class of germs. *That this white non-coloring substance is a secretion of the two poles, or coccoid ends, of these "belted" germs, as well as that it has a different chemical composition, is beyond all question.*

The phenomenon above spoken of, as anticipating the formation of the segmenting white line which separates the two darker portions of these organisms is: *that this white substance first appears in the centre of the body of the dense, dark ovoid object as the minutest of white specks, which gradually increases in size and quantity, and extends across the entire object;* the white line, *being at first broader in the middle, but gradually widening until it completely and clearly separates the two pole (coccoid) ends, and the mature object is again presented to our view* (Fig. 6).

We have thus described the normal, or general, cycle of development of the micro-etiological organism of the *American, English and German Swine Plagues, the American Southern Cattle Plague, Hen Cholera, the German "Wild-Seuche"* (of deer, swine and cattle) and *Rabbit Septicæmia,* all of which diseases are caused by a

member of this class of "belted" germs, and should be classed as extra-organismal, local or land septicæmiæ. It seems to me that the germ of Yellow Fever, as well as the disease itself, should also come into this group.[1] I am sorry to say that, notwithstanding the results claimed by Freire, I am unable to find a single exact and detailed description of the germ with which he works, and which should therefore be the etiological moment in the Yellow Fever, if there is any trustworthiness in Friere's statements.

Morpho-biological Resemblances not sufficient to Pronounce Pathogenetic Germs or Diseases caused by them Identical.

This part of my work would be left incomplete did not I allude to an endeavor of Hueppe's to show that the diseases named above, aside from the Swine and Southern Cattle Plague of this country, are *identical,* that is, the German, Schweine-Seuche, Hühne-Cholera, Kaninchen Septikamie und Wild Seuchë must all be one and the same disease; *because their germs have each and all the same form, the same size, the same "belted" appearance, and because they all grow alike in bouillon, on agar agar and in gelatine.*

The Germans do not say anything as to how these germs deport themselves on potatoes. *The Schütz-Loeffle germ does grow on potatoes,* as Professor Kitt, of Munich, assures me.[2]

No greater or more misleading statement could be made, or perhaps it would be better to say principle or theory enunciated.

The most complete morphological resemblances and exact morpho-biological relationship in or on artificial media are not sufficient grounds for any such attempt at generalization as Hueppe's in the case of these diseases.

To all beginners in this work, and all older hands as well, I most emphatically assert that there is but one factor in the biology or morphology of etiological micro-organism which can decide whether two germs apparently alike are one and the same object, when derived from two distinct diseases of animal life.

That factor is a physio-chemico-biological one. Both germs must produce the same disease in both species of animals: the same chemical and pathological phenomena which occur in the same diseases and

[1] Confirmed as herein stated by researches subsequent to the preparation of this paper.

[2] Colin says the same.

in the same species of animals under natural conditions, when healthy animals of the given species are inoculated with artificial cultivations of the germs in question. Our experiences here completely upset Hueppe's hypothesis.

The American Swine and Southern Cattle Plague should, according to Hueppe, be identical diseases with those mentioned as considered so by him in Germany, because, according to his condition, *the germs are identical.* Hueppe's entire argument is completely nullified by the following facts:—

First.—*There is no Southern Cattle Plague known in Europe.*

Second.—*Cattle and Swine run together in this country, and one or the other may have respectively Swine or Cattle Plague, and yet the other species will never become ill, even from the closest contact with members of the other species sick with its peculiar plague.* Hens can feed on hogs dead from the swine plague, from the ground polluted with their discharges, even picking out grain from the same, and still remain well; and the same is true of the hogs with regard to Hen Cholera and the Southern Cattle Plague.

Hence, no matter how these germs may resemble each other, when artificially examined, they fail in the one great factor necessary to make the diseases produced by them identical; they do not have the same physiological chemical attribute with regard to a given something produced, which invariably decides the pathogenetic results produced by a given germ. Notwithstanding the latter fact, these diseases all have a very close relation to one another. *They are all extra organismal, local land septicæmiæ.* Each one, however, has something peculiar about them that prevents them from being identical diseases, aside from any action of the germ.

Each species of animal in which they occur has some unknown constitutional idiosyncrasy which renders its members susceptible to the action of a given germ, and each of these germs has some peculiar unknown biological idiosyncrasy by which alone it infects, naturally, but a given species of animal life.

These two factors, together, can alone decide the identical question. What we can do artificially, by the inoculation of those animals that the disease does not occur in naturally, has no necessary relation to the question whatever.

There are, however, other phases in the development of these germs of a bio-morphological character. For instance, as already said, we may see two or three individuals of the mature type united

together (Fig. 2), or we may find two apparently mature organisms enclosed in a common capsule, the two medial dark points or poles being in such close apposition that no line of demarcation or indentation of the capsule can be seen at this point, the whole outer surface being smooth (Fig. 7). On the other hand, the two lateral ends, or free poles, are separated by the normal quantity of white, non-colorable substance.

Again, these diplo-bacteria may assume a curved or sausage shape, which we may sometimes see intimated in the single organism, mature (Fig. 8). At other times, though not very frequently, the germ may appear in nearly its normal form, but one pole (coccoid) end will be semisegmented from its appositional end of the white substance by a constriction of the same at its line of attachment with the pole end (Fig. 9). This end will then be smaller than the opposite pole, thus giving a sort of pear shape to the entire organism: the small pole end is soon dropped, however, and becomes momentarily a free coccoid, and goes through the cycle of morpho-development already described; the same occurs with the other pole end.

This concludes my observations of the micro-morpho-biological phases presented by these two micro-etiological organisms in the course of their development. There may be some minor phenomena that have escaped my attention, but I am very sure I have described all the essential points.

The Swine Plague and Southern Cattle Plague Germs Differentiate themselves very sharply by their Appearance when Cultivated on Potatoes.

If we properly prepare (see text-books) and sterilize some nice, clean potatoes, and then place them (*lege artis*) in a sterilized, moist, cultivating chamber, and inoculate the cut surface of some of the potatoes from Agar Agar, Boullion or other cultivations of the microörganisms of these two diseases, we shall invariably find that they can be readily differentiated from one another in the course of from twenty-four to forty-eight hours after the surface of the potatoes has been inoculated. *The growth of the germs of the American Swine Plague will invariably present a peculiar brownish-yellow to the eye, reminding one of coffee color,* especially the variety one gets in the ordinary boarding-house and restaurant.[1]

[1] Colin says "greyish."

On the other hand, the micro-etiological *moment of the Southern Cattle Plague will with equal constancy present a growth of the most delicate straw color during the first day or so of its development, but which soon begins to show a delicate pinkish, red-yellow, and finally quite a decided brick-red-yellow shade, as the cultivation becomes antiquated; this reddish shade begins and grows most intense at the centre of the growth, leaving it more yellow toward its peripheries.*

THE DEPORTMENT OF THE GERMS OF SWINE PLAGUE AND SOUTHERN CATTLE PLAGUE IN BEEF-INFUSION GELATINE.

As what is known to us as beef-infusion gelatine cannot be used in hot weather, or when the prevailing temperature is above 75° F. (23° C.), on account of its becoming fluid, I could not use this material until the last moment, and only prepared the first of the season on Saturday last, October 1, and on Sunday was enabled to inoculate tubes of this material with from pure cultivations of the germs of Southern Cattle Plague and hog cholera. This beef-infusion gelatine is an invaluable medium in the technique of bacteriology, for two essential reasons: First, being transparent, one can see what is going on on it, and, secondly, many micro-organisms cause the solid material to become fluid, and present peculiar phenomena to the eye, while others do not cause any change in it, but may grow in a peculiar manner.

Now the hog-cholera germs belong to the latter class, as well as the germ of the German, French and English swine plagues, which are probably identical with hog cholera, as also those of hen cholera, and the peculiar disease known as "wild Seuche" in Germany, which affects the deer tribe and cattle and hogs, and belongs to the same blood-poisoning group as hog cholera.[1] When we take our hog-cholera germ, and inoculate tubes containing this beef-infusion gelatine from the pure agar agar cultures, we shall observe that the germs do not cause the gelatine to become fluid, and that it never becomes so, so far as any influence of the hog-cholera germs goes, if the culture from which the material has been taken was a pure one, that is, contained no other form of micro-organismal life than the germs of hog cholera.

This germ, however, has other peculiarities; it slowly spreads

[1] The germ of the English Swine Plague was first discovered by me in 1886, in some tissues from England belonging to my then assistant, Dr. Bowhill, M.R.C.V.S.

over the surface of the gelatine as a delicate cuticle, but, as these cultures are made by puncturing the gelatine with a wire, the germs are carried into that substance by the wire. Here we observed that everywhere the wire has left a germ in its passage through the gelatine, that a small colony develops, giving to the puncture the appearance of a delicate thread with knots along its course. In the end these colonies unite, and give the puncture a ragged-edged appearance. As the germs of the German swine plague, and rabbit-septicæmia, and the "wild Seuche" all do the same thing, Hueppe asserts them to be the same organism. Hueppe has tried to claim that all these diseases were one and the same, a mistaken view, as I have tried to show.

I have now to chronicle the first serious error, a genuine mistake of carelessness, from undue haste, that I can charge myself with during my investigations of the two micro-etiological organisms here considered.

Above it was said that on October 2d two beef-infusion gelatine tubes were inoculated from pure cultivations of the germ of the Southern Cattle Plague, and in the local papers the following remarks were published:

"Now it became interesting to see how this Southern Cattle-Plague germ would deport itself in this gelatine, because it cannot be distinguished from that of hog cholera under the microscope, or on agar agar, or in bouillon. That it can be by its growth on potatoes has been already noted. Hence, on Sunday, October 2d, gelatine tubes were inoculated. You can judge of my surprise on seeing that this Cattle-Plague germ could be at once distinguished from those of hog cholera standing beside it. The germ of the former had caused the gelatine to become fluid to the bottom of the puncture in twenty-four hours, which is quite rapid work."

The above was scarcely in the hands of the readers of the two journals before I began to have grave doubts of the correctness of my observations, simply because *all other known germs belonging to this "belted" group, and the cause of extra organismal septicæmiæ, do not cause the gelatine to become fluid.*

In order that others may profit by an error which is unpardonable on my part, I will briefly tell how it came about. At the time I had just twenty agar agar cultivations of the germs of the Southern Cattle Plague, which I looked upon as pure, and which represented the outbreak at Tekamah and Roca, my inoculated

steer, and material from a ground squirrel. In making the gelatine tube, *I simply inoculated from one agar agar tube on two gelatine tubes, with no other precaution than a macroscopic comparison of the growth with those in the other agar agar tubes.* I could see no change in the appearance of the growth of the tubes I used. *I should have made, and every one should always make a few cover-glass specimens for the microscopic test in all such cases.* (In the case of these germs, it would be futile, however.) After the cultures in the gelatine had become fluid, I then inoculated the entire agar cultivations (twenty) upon gelatine, and carefully numbered each tube with a corresponding number, so as to control the number.

This time I was not at all surprised where in nineteen of the beef-infusion gelatine tubes no fluidification had taken place, the same occurring in the one as before and from the same agar tube. It is now February 6th, and the tubes remain exactly as they were on the 8th of October.

Hence, *the germs of the Southern Cattle Plague,* like those of the American Swine Plague, and other diseases of the same group, that are caused by the belted oval germs *do not cause fluidification of gelatine media.*

I next inoculated twenty pieces of sterilized potatoes (and for comparison's sake twenty others from cultivations of the Swine-Plague germ), and here *I found no change in the appearance of the growths from those previously described.* From the twenty potatoes culture of the Southern Cattle Plague germ I again inoculated twenty gelatine tubes. *Nineteen remained solid; one became fluid.* As the potato culture from the tubes which caused the gelatine to become fluid did not show any variation in the color of the growth upon agar agar from the others, I resorted to plate cultivations as well as the microscope to solve the riddle.

This one tube contained a small number of the most contemptibly small micrococci, yet enough to have got me into a serious error. They required 2,000-diameter amplification to see them distinctly, and, as I have said, Micrococci constitute a normal morphos in the development of this class of germs, their presence would have excited no suspicions had I subjected the original culture to a microscopic examination. Still it should be done in every case, so as to keep up a good rule.

They were separated with ease on plates. Inoculation upon Gophers with the mixed culture gave fatal results, but no cocci

could be found in their blood or tissues, nor did any develop in tubes inoculated from them. Inoculation upon Gophers and mice with pure cultivations of the troublesome cocci gave absolutely negative results, no disturbance except a little stiffness and swelling of the limb occurring.

The reason that the color of the agar agar, and especially potato cultures of the Swine Cholera-Plague germ was not affected by these cocci was that the former are so much larger and grow so much faster as not to be much affected thereby on that medium; while in gelatine this whole group of germs finds a poor nutrient material, and grow very slowly; on the contrary, the small cocci grew exceedingly fast in the gelatine, and also caused its fluidification with greater rapidity than any pathogenetic organism with which I am acquainted, not excepting Finkler's and the cheese "Comma." Second, they are almost transparent, and have no chromogenic properties.

That they had less specific gravity than the Southern Cattle-Plague germ could be determined by a microscopic examination of the material at the apex of the fluidification, by tipping the tubes gently; here the Southern Cattle Plague organism greatly predominated.

The Growth of the Germs of Southern Cattle Plague in Beef-Infusion Gelatine as Compared with those of the American Swine Plague.

While neither of these micro-organisms cause fluidification of the beef-infusion gelatine, still there are certain minor points which have a degree of differentiating value for each of them.

The germs of the Southern Cattle Plague have more desire for the air than those of the Swine Plague, they are more ærobic; *while they spread slowly over the surface of the gelatine, still they do it more rapidly than the swine-plague organism.* Along the line of puncture in the substance of the gelatine there is, however, no perceptible difference in the deportment of the two germs.

They each form individual colonies along the line, which gives to it an irregular jagged appearance, resembling the cutting edge of a saw.

If anything, this surface is more dentoid in the Southern Cattle Plague cultures than the Swine Plague growths in beef-infusion gelatine.

This concludes my present observations upon the development of these etiological organisms in and on different cultivating media. Not having a refrigerator, I have not compared their developments. upon blood serum up to the present time.

Now these facts of some of the biological (or life) characteristics of these two germs show that, while two germs may look alike and grow alike, even in every particular, they may have one other attribute which in such cases can only be relied upon to detect one from the other.

That is their origin or, in other words, their disease-producing action.

It needs no argument from me for the practical farmer to know that the Southern Cattle Plague will not produce hog cholera in his hogs, or the latter disease the Southern Cattle Plague in his cattle.

ON SOME INTERESTING DERIVATIONS OF MINERAL NAMES.

BY F. M. ENDLICH.

(Continued from January Number.)

3. In addition to those mineral names which have undergone curious changes in the course of time, there are others which show interesting etymological relations, and yet have descended to us in but slightly changed form.

KERMESITE is derived from the Sansk. *krimi,* worm; Pers., *kirm* or *kirmis,* scarlet; Ar., *alkirmis;* Sp., *alkermes;* G. obs. *Kermes,* the "scarlet bug," cochineal insect. *Chermes,* the druggists' name for the substance, reached Spain from Arabia and thence travelled to Italy and Germany.[1]

The Sansk. form *krimi* has been retained in our Engl. *crimson.* It is also recognizable in the Lithuanian *kirminis,* worm. In It., Fr. and, later, Sp., the letter *a* was substituted for *i* and *e,* resulting in *carminio* and *carmine:* whence the mineral name *Carminite.*

[1] "Chermes vocant Arabes vnde nos chermesinum; sev et vermilium vsurparunt quidam, a vermiculis exemptis a radice pimpinellæ; coccum autem alio nomine dicitur scarlattum." (Cæsius, 1636.)

AZURITE.—The immediate derivation of the word is from N. L. *azurum*, sky-blue. Originally it comes from the Pers. *ladyuward*, or *lazuward*. In M. H. G. the adjective *lassuvar* appears, which has survived in the H.G. under the form of *Lasur* and *Kupferlasur*, copper-blue.

During the reign of Emperor Augustus, about 20 B.C., the L. word *azulus*—Lapis Lazuli—is met with. (M. Vitr. Pollio, the architect.) Early in the fourteenth century the N. L. *asureus* occurs, the initial *l* having disappeared in Latin. In the recent forms—It. *azzuro*, G. *azur*, Fr. *azur*, Engl. *azure*—the original *z* takes the place of the N. L. *s*; but in O. Engl. the latter can be found:—

> . . . . . . "a broche of gold and assure,
> In which a ruby set was like an herte."
>
> —*Chaucer*, 1340-1400.

In the sixteenth century, however, the word had assumed its present construction:—

> . . . . . . "that deckt the azure field."
>
> —*Spenser*, 1552-1599.

Lapis Lazuli owes its derivation to the same source, and, like the G. Lasur, has retained the initial *l*. "*Azurri ultramarinum materia ex lapis lazuli*" (Cæsius, 1636), shows the Latinization of the It. word.

MARCASITE is derived from the Ar. *markashitsa*, pebble.[1] The word was introduced in the thirteenth century, and was especially applied to minerals which showed bright, metal-like lustre (*Kiese* of the Germans). It was known to Alb. Magnus (1280) under the form of *marchasita*, and he characterized it as a mineral out of which no metal could be extracted by fire. Two kinds, mainly, were distinguished—the one yellow, shining like gold (*pyrite, etc.*: "*Pyrites sine dubio Arabib. marchasita est*" [Agricola, 1546]); the other, purer and more valuable, like silver (*marcasita argeneta* of the alchemists, *bismuth*).[2] One characteristic of the *marcasites* was

[1] Personal communication from the Arabic scholar, Rev. Wm. Wackernagel, D.D.

[2] "Marchasitarum species multe ac diuersæ sunt, ... nam alia aurea; alia argentea; alia cuprea. ab igne non liquefit; sed per se comburitur." (Leonardus, 1610.)

that they nearly all contained "brimstone" (Cotgrave).[1] According to Boyle (about 1670), "*Marchasitical stones*" abound in those portions of the earth where the temperature is excessively high. From various old writers, it would appear that the Arabic physician Avicenna (about 1020) had previously used the name. A rather fanciful derivation brings the word from the Ar. *marv, kyass, idd*—whitish, glistening flint (Kobell).

4. Among the mineral names there are some which have retained their original form with surprising regularity and have distributed it through many languages.

JASPER descends from Heb. *iashpheh*, Ar. *iasheb* or *iashef*, Pers. *iashm*, Gr. *ἰάσπις*, L. *iaspis*, M. H. G. *jaspis*, O. Fr. *diaspre*, Fr. *iaspe*, O. Engl. *jaspe*, *jaspre*, Engl. *jasper*, H. G. and Sw. *jaspis*.

"His stone is jaspe."
—*Gower*, about 1360.

"The floore of jasp and emeraud was dight."
—*Spenser*, 1552-1599.

Ἴασπις is used by Plato (429 to 348 B.C.) and others after him; L. *iaspis*, by Virgil and Pliny, over eighteen hundred years ago.

SAPPHIRE is derived from Heb. *sappir*, Ar. *safir*. In Gr. the two *p's* of the Hebrew persisted, but the second was aspirated: *σαπφειρος*. M. H. G. used the word *saphir*; O. Engl. *saphire*:—

"Of rubies, saphires and of perles white."
—*Chaucer*, 1340-1400.

In It. the word has become *saffiro, zaffiro*; in Sp. *zafir*, Fr. *saphir*, Sw. *safir*. The H. G. and Engl. versions, however, retain the two *p's*, as in the Greek.

The It. *zaffiro* was perpetuated in obs. G. *zaffer*, used to designate blue cobalt-glass and blue colors; Engl. *zaffre* describes a purplish cobalt color.

Σαπφειρος was used by Dionysios Periegetes about nineteen hundred years ago, apparently in connection with the gem which now carries the name. Pliny also describes "sapphires," but evidently not the precious stone, as he states that it glitters with marks and specks of gold; this would apply to *Lapis Lazuli*.[2] Agricola (1546)

[1] Gessner (1565) claims the following: "*Pyrites recentiores marchasitam vocant, nostri corrupto nomine martistein.*"

[2] "*Sapphirus enim et aureis punctis collucet.*"—Pliny, Venice edition.

uses the correct orthography, "sapphirus;" as does Kentmann, in 1565.

ARSENIC.—The origin of this word is Gr. *ἀῤῥην*, or, as the second of two ς's frequently changes to a σ, *ἀςσην*=L. *mas*, strong, masculine. By transposition the word *ἀνης*=man, is formed from *ἀῤῥην*, the one ρ being dropped.

Homer uses *ἀνηρ*, 880 B.C., and, after him, all other writers. In Sophocles, however (497 to 406 B.C.), we still find *ἀρσην*, in the sense of strong; also in Aristophanes (412 B.C.).

"*κτυπος ἀρϐην ποντου*" (noisy, powerful sea), Sophocles.

Theophrast writes *ἀῤῥενικον*, about 300 B. C.; Galenus (A. D. 131 to 202) employs *ἀρσενικον*, a poison. It is probable that the older forms were used to designate a variety of strong poisons, mineral or vegetable.

Curiously enough, the form *ἀρσην*, without the lengthening termination *ικον*, has survived in the G. *Arsen*, which signifies *metallic arsenic.* The Latinized form of *ἀρσενικον* or *ἀρσενικιον*, which latter was used by Aristotle (384 to 322 B.C.), is *arsenicum:* whence G. *Arsenik—i.e., arsenic oxide*—O. Engl. *arsenik* (Pettus, 1683) and Engl. *arsenic.*

DIAMOND.—Derived from contr. Gr. *a, privativum*, and *δαμαω*, I conquer=unconquerable. The name was originally given to hard steel and iron, and Hesiod uses it in this sense about 750 B.C. Since the days of Theophrast (about 300 B.C.) it has been applied to diamond. Gr., *ἀδαμας*.

The word enters Latin as *adamas.* "*Unde et nomen indomita quis Greca interpretationes accepit*" (Pliny). Pliny claims that when laid upon an anvil and struck with a hammer, the *adamas* will cause the latter to recoil and will remain unharmed, if, indeed, it fail to burst either sledge or anvil: hence its name. Only by sprinkling upon it the blood of a male goat can it be reduced to such a condition that it will no longer withstand the heaviest blows.[1]

In the middle of the sixteenth century the word was *Dyamant* in Germany; M. H. G., *Diemant;* H. G., *Demant* and *Diamant;* It. and Sp., *diamante;* Fr., *diamant;* O. Engl., *diamaunt;* Engl., *diamond.*

> "Haue harte as hard as diamaunt—
> Stedfast and naught pliaunt."
>
> —*Chaucer*, 1340–1400.

[1] "*Adamantem opum gaudium infragilem omni caeteri et inunctum sanguine hircino rumpente quæque.*"—Pliny, Venice edition, 1559.

The original form of Gr. ἀδαμας has been retained in the Engl. adjective *adamantine*=diamond-like, and in other words :—

> . . . . "three folds were brass,
> Three iron, three of adamantine rock."
>
> —*Milton*, 1660.

MACLE is the name of a mineral which, when broken across its principal axis, shows a white cross or rhomboid spot enclosed within a dark matrix. The word is derived from L. *macula*, spot. G. *makel*, blemish ; Engl. *maculate*, to spot, and *immaculate*, are from the same root, as is Fr. *macule*, spot. *Macula* is classical, and may have reached the Romans from Gr. μαχελον=inclusion, mark. *Pierres de macle* was applied to the mineral in 1751 by Robien. (Dana.) The meaning of Fr. *macle* is "*perforated rhomb*": whence its application to the mineral, which often shows such a figure on cross-section.

CARBUNCLE.—Pliny uses the name *carbunculus*, a diminutive of *carbo*=coal, in allusion to the resemblance of the gem to a glowing coal. In G. the *b* has changed to an *f*—*Karfunkel*—but remains *b* in Sw. *Karbunkel.* It is a coïncidence that the G. *funkeln* means glowing, scintillating. "*Carbunculi a similitudine ignium apellati.*" (Pliny.)

While the Greeks had a totally different name for the mineral, it is interesting to note that the origin of both the L. and Gr. words refer to the same peculiarity—*i.e.*, to some *glowing light.* The Gr. name is derived from λυχνευω=I shine brightly, I light up.

SMALTITE.—The Gothic form of *smalyan*, *smalteis*=melt, or smelt—was *smalzian* in M. H. G.; then *smelzan* (G. schmelzen); and these resulted in the M. L. *smaltum*=glass-flux. In the ninth century M. L. *smaltum* was used in the sense of smelted substance=*enamel*—in describing a "*crux pulcherrima gemmis et smaltis.*" (Anastasius.) It. *smalto* and G. *Smalte*, as well as M. L. *smaltum*, were finally applied to the blue cobalt glasses and cobalt colors, which became known about the middle of the sixteenth century. Since that time the word has retained its specific meaning. H. G. *Smalte* or *Schmalte*, Fr. *smalt*, Engl. *smalts*, Sw. *smalts*, all designate the color or substance known as cobalt-blue.

STANNITE is derived from L. *stannum*, originally *stagnum.* It is probable that the word is of Celtic origin; and the Irish *stan*, Welsh *ystaen*, may be regarded as direct descendants from the old root. Sueton and Pliny knew *stannum* as an alloy of tin and lead.

The old form of *stagnum* produced It. *stagno;* later, *stagnuolo:* whence obs. G. *Stagnol,* H. G. *Stanniol*=tin-foil. From the same source are Sp. *estano,* O. Fr. *estain,* Fr. *etain.*

In O. H. G., *tin* was *zin;* in A.-Sax., *tin*—possibly related to Sansk. *tshina,* lead; obs. G., *Zien* (1743); H. G., *Zinn;* Sw., *tenn;* D., *ten;* Engl., *tin.* The Engl. words *stannary*=tin-mines, and *stannous,* retain the Celtic (?) root. G. *Zinn* and *Zink* probably have a common origin, but the connection is obscure.

A derivation from A.-Sax. *tynan*=to shut, close, fasten, hence *solder,* has been suggested for tin, but seems untenable.

5. There are a number of mineral names which derive special interest from their application. The peculiarities ascribed to *Wolfram, Nickel* and *Cobalt* are productions of the German miner, whose fertile imagination saw more than mere matter-of-fact circumstances. Since the twelfth century mining has been prosecuted in Germany; and it can readily be imagined with what strange creatures the superstitious workman of those early days might people the underground domains.

WOLFRAMITE.—The word is of German origin, being a contraction of O. H. G. *wolfhraban.* The latter is formed by a combination of *wolf,* wolf, and *hraban,* raven. Among the ancient Germans, in fact, until the introduction of Christianity became general, the meeting with a wolf or a raven was considered a favorable omen under nearly all circumstances; and the most emphasized indication of coming good fortune consisted in meeting both of these animals. In the tin-mines of Germany and Bohemia, as well as in a number of silver-mines, the occurrence of *Wolframite* was an almost infallible index of the vicinity of good ore: hence the application of the name.

Wolfhraban contracts into *wolfhram* [*Wolffhram,* as late as 1565 (Fabricius)], and, by dropping the h, into *Wolfram. Wolf* was for many years a favorite baptismal name in Germany, and may be found to this day in some families of feudal descent. Wolf is derived from Goth. *vulfs* and A.-Sax. *vulf,* with the root of Goth. *vilwan*=L. *rapere,* to lay hold of, to tear.[1]

[1] *Wolframm* and *Wolffert* were used as late as the last century. The name is then explained as indicating that this mineral, when brought together with tin-ore in the furnace, wasted the tin—ate it up as a wolf

The Sansk. *karawa* is the root of Gr. *κοραξ*, L. *corvus*, It. *corvo*, Sp. *cuorvo*, Fr. *corbeau*, Engl. *crow*, G. *Krähe*, Sw. *Kraka*, D. *Kraye*, on the one hand, and, on the other, of A.-Sax. *cravan*, O. H. G. *hraban*, G. *Rabe*, Fr. *ravineux*, Engl. *raven*.

The derivation of Wolfram from *Wolf* and G. *Rham*=cream, is faulty. The Engl. name for G. *wolfram* is *tungsten*, der. Sw. *tungsten*, from *tung*, heavy, and *sten*, stone.

NICCOLITE, in this form of orthography, is derived from N. L. *niccolum*, the metallic element, formerly *nickelum* (latter part of eighteenth century). The Goth. *nickr* or *nickl*, A.-Sax. *nicr* or *nicor*, Icel. *nikr* (related to Icel. *hnickia*=to seize and carry off), was a demon who inhabited pools of water and drew down his victims with irresistible force until they were drowned. From the above is derived the G. *Nixe*, a female water-spirit, who was not always cruel, but sometimes gave her valuable services to unhappy lovers and others who sought hei aid. The G. masculine *Nix* belongs to the same family, but was a morose, objectionable character. His name serves to this day in Germany to drive children away from water. From the same source we have obtained the appellation "*Nick*," commonly used as "*Old Nick*," now employed as a *nom de plume* for the chief of the infernal regions, although the original association of the name with water is hardly in keeping with the orthodox conception of this warmly-located ruler.

In O. H. G. *nickel* signifies a small horse, especially a vicious one; also a dwarf. The A.-Sax. *nag* is related to it. Locally, the idea of a dwarf or stunted animal of any kind was modified into the personification of a malicious, mischievous spirit. In this connection, the words Engl. *nagging* (from A.-Saxon) and G. *necken*, to tease, were used.

The German miners frequently found ores which looked very promising, but, upon being smelted, they produced no silver: on the contrary, they emitted foul and noxious odors. The most natural explanation, at that time, seemed to show that wicked, envious spirits had changed the ores, or even infested them: whereupon the terms *nickel* and *kobold* were freely applied to such disturbing ele-

would. "Er (wolfram) betreugt die Berglente gar sehr, weil er mit dem Zinnstein vor dem Wasser stehet und im Schmeltzen das Zinn raubet." (Bergwerck's *Lexicon*, 1743.) *Wolfram* was also used for some arsenical ores which are objectionable in the furnace. (*Mineral. Belustigungen*, 1768.)

ments. An association of "*nickel*" with the name of any other metal expressed the old Germanic idea of a "*changeling*" (G. *Wechseling*, from O. H. G. *wihseline*), derived from the fancied changing of children by elves and fairies. Thus, *copper-nickel* would be the name of a mineral resembling copper-ore, yet containing none of the latter metal: the meaning would be equivalent to "false copper."

In this way the names of *nickel* and *kobold* became attached to certain minerals which resembled rich ores, but yielded neither silver nor copper. To this day the word nickel is applied to persons in certain parts of Germany when a giddy, or even vicious (generally female), character is to be described.

An ore known as *Kupfernickel* in Germany, *coppar-nickel* in Sweden, yielded a grey, hard metal to the Swedish mineralogist Cronstedt, in 1754, which he named *nickel.* He took the name from the ore. Promptly discerning that the metal he had obtained bore no relation to the first part of its name, copper, he selected the second. Thus the word which had first been applied by the miners was eventually attached to the metal which had caused them so much worriment.

COBALTITE is immediately derived from N. L. *cobaltum,* the metallic element. Agricola says (1546): "*Est prœterea aliud genus ferrei quasi interdum coloris, cobaltum nostri vocant.*" In O. H. G. the word is *Kobolt,* sometimes *Kobalt*; in the sixteenth century, *Kobelt* and *cobelt,* or *cobel;* H. G., *Kobalt;* Sw., *kobolt.* It is a descendant of the Gr. *κοβαλος,* L. *cobalus,* whereby a familiar spirit was designated. This spirit was not necessarily vicious or ill-natured, nor prone to do harm, but he was full of mischief and fond of practical jokes. Aristophanes (about 406 B.C.) characterizes a *κοβαλος* as a satyr, a roguish fellow, in the following of Bacchus. The Fr. *gobelin* and Engl. *goblin* are derived from the same root. An amusing explanation of their etymology assigns Fr. *gober*= gobble, as their root and that of kobold, because nurses are apt to tell children tales of spirits that will "gobble" them as a punishment for disobedience and other childish peccadillos. (Minshew.)

In Germany the *Kobold* was rather useful than otherwise, unless he was crossed in anything.[1] Of a particularly industrious servant

[1] Of the "Berg-Kobelt" (mountain spirit) the following is said: "Es lässt sich in allerhand Figur sehen, bissweilen als ein kleines Kind. auch wohl als ein alter Bergmann, nur muss ihnen nichts in Weg gele-

it was said: "*Sie hat einen Kobold*" (a kobold is with her); and it was believed that this amiable spirit assisted her in her daily work. The underground association with nickels, however, must have tended to corrupt the kobold's kindly disposition and to sharpen his enjoyment of practical jokes, which he carried even to the point of cruelty. He disturbed and hid the tools of the miners, interfered with their timbering, changed their ore, and played a thousand distressing pranks. When the workmen proceeded to smelt silver from their ores, he caused the latter to emit mal-odorous, choking fumes in such dense masses as to injure the smelters. "*Kobelt'sche Ertze sind wilde und strenge Ertze.*" (1743.) The heavy, white smoke spread itself upon the grass of the fields and killed the cattle. At last the kobold became identified with this fuming, smoking class of arsenical ores, so that Mathesius, in 1562, describes cobalt as a "poisonous and injurious metal." Linnæus mentions arsenic (the source of the fumes) as Kobolt, and to this day the "*Scherbenkobalt*" of German miners is but a variety of metallic arsenic.

The metal cobalt was not extracted from its ores until Brandt, in 1733, produced it in a somewhat impure state. Its blue glasses and slags became known about the middle of the sixteenth century by accident: a workman secretly threw a piece of the evil-minded "kobold" into his employer's glass-furnace with the intention of causing the spirit to work dire mischief: the most beautiful blue glass resulted.

BASANITE is derived from Gr. *βασανος*=touchstone, probestone. It is used by Pindar in this sense as early as about 490 B.C. The word is formed from *βασανιζω*, possibly produced by contr. Gr. *βασις*, foundation, bottom, and *νιζω*, I wash, clean—conveying the idea of "*sifting to the bottom.*"

The Latinized form, *basanites*, was indifferently applied to black quartz, the true probestone, and to *basalt*, the eruptive product. It has been claimed that a "typographical error" on the part of some early copyist bore the responsibility of having produced the latter word. The transition from *basanites* to *basaltites* seems easy. Pliny (A.D. 70) uses *basaltes*, a marble from Ethiopia, and speaks of the name as having been used before his time.

get werden, so lässt es die Berg-Arbeiter auch zu frieden." (18*th Century*.)

It is known to be a fact that *basanites* was applied to true *basalt.* Agricola (1546) uses the word for an undoubted basalt; Gessner (1565) derives it from Gr. *βασανω*, and applies it to true basalt;[1] Kentmann (1565) calls it "black marble," and uses the word in the same way;[2] Basanite is described as "black stone" by Leonardus (1610), and he speaks of "*Bazanites sive Basaltem lapis;*" Cæsius quotes it as "*iron-colored*" marble, in 1636; in 1743 (Bergwerck's *Lexicon*) it was regarded as a dark-grey marble ("*schwarzgrauer Marmor*"); within the last fifty years *Basant* and *Basalt* have been used synonymously in various German publications. This confusion of the two terms may bear out the idea of an early "typographical error."

CELADONITE is formed from the Fr. *celadon*=sea-green. The origin of this word, in its quoted meaning, seems to be a curious one. Gr. *Κελαδων* first occurs in the "Iliad" (880 B.C.) as the name of a river; subsequently it is repeatedly used in the same way by Meleagros, Strabo a. o.; Ovid incidentally applied it, in the form of *Celadon,* as the names of two men, one from the mouth of the Nile, the other from the mountains of Thessaly. The word is derived from Gr. *κελαδος*=rushing noise, like that of rushing water.

In 1610 (1616?) a French novelist, D'Urfée, wrote a pastoral romance, "*Astrée,*" in which he gave the name of *Celadon,* borrowed from Ovid, to an inexperienced, insipid lover: whence the idea of greenness (Dana). Spanish (?), French and German all contain the noun *Celadon* or *Seladon*=verdant lover (G. *blöder Schäfer*), and the adjective=sea-green. In Engl. the latter has been amplified to *celandine.* In the acceptation of verdant lover, the word seems to have come from the Spanish rather than from the French, but it is difficult to arrive at its meaning for any given date. There was an ancient river *Celadon* in Spain, whence the word may have been introduced into that language. Thompson uses the name, in 1727, in "The Seasons," for Amelia's lover.

Dana gives the derivation from Gr. *κελαδων*=burning; others from *χελιδονιον*=swallow-wort. But neither seems to apply.

AMETHYST is composed of Gr. *α privativum* and *μεθυω*, I am

[1] "*His omnibus consideratis non immerito Misenus βαβανω, vel Basaltes Misenus dici potest,* EIN MEISSNISCHER PROBIRSTEIN."

[2] "*Marmor nigra Stolpense, ferreo colore et duricie, hoc Bisalten nominat Agricola; nos Basalten.*

drunk: hence it signifies a safeguard or amulet against inebriety. Some of the ancients claim that it prevents the latter, but Plutarch denies it. Among its numerous wearers of the present day, some may be able to judge of its supposed merit in this direction.

"Magorum vantitas resistere ebrietati eas promittit et nide appellatas."—*Pliny.*

The amethyst is mentioned by Plato (400 B.C.) and Asclepiades (280 B.C.) as a gem.

6. A few mineral names have reached us from the Anglo-Saxon with hardly a change and without having lost their characteristic brevity :—

WAD is a bog-ore of manganese. The word takes its origin from A.-Sax. *vaed*, bunches, derived from the Goth. *vidan*=to bind (in bunches). We further have: O. H. G. *wat, wetan, gawati;* M. H. G. *wat;* Scandinavian *vad;* Sw. *vadd*—related to G. *Watte* (cotton-), batting, and to Engl. *weeds.*

FLINT has been referred to Gr. πλινθος=tile or brick, and to Gr. πληττειν=to strike, in allusion to striking fire; but these derivations seem very problematical. The word in A.-Sax. was *flint;* M. H. G., *vlins;* locally (Middle German), *vlint;* O. Engl., *flent;* Sw., *flinta.*

"And out of flent sprang flod, that folke and bestes dron ken."
—*Langland*, 1362.

French *flin* means polishing material, for which powdered flint may be used. The word *flent* or *flint* may be related to the root of *flensing*=to skin, to flay (Icel., *flisia*), as in the earliest times flint, particularly, and other stone implements were used for skinning animals.

The form *flint* was assumed long ago :—

"Had ben my heart of flint, it must haue melted."
—*Surrey*, about 1520.

The H. G. *Flinte*=(shot-), gun, is the same word applied to firearms since about 1640, when they were first supplied with chips of flint or chalcedony for the purpose of striking fire and igniting the powder.

7. Matters of historical interest are also alluded to in mineral

names, but, usually, refer to some scientific work rather than to political occurrences.

TANTALITE is a name given by the Swedish mineralogist Ekeberg to a certain mineral in 1802. He thereby expresses the difficulties and tantalizing perplexities with which he was beset during the progress of his analysis of the substance. It is named after *Tantalos*, the well-remembered mortal favorite of the Olympian deities, who so far presumed upon his privileges as to place before them the remains of his own son, disguised as a tempting dish. For this sacrilege he was condemned to suffer hunger and thirst in the nether world, though surrounded by luscious fruits, viands and liquids of all kinds, which promptly receded from his grasp whenever he reached for them.

Certainly, the name forcibly expresses the feelings of the baffled chemist, while at the same time it affords a glimpse of the status of analytical science in 1802.

XENOTIMITE.—In 1832 the famous French mineralogist Beudant named a mineral Xenotime, apparently from contr. Gr. *ξενος*, a stranger, and *τιμη*, honor. He explained, however, that this name was derived from contr. Gr. *κενος*, empty, vain, and *τιμη*, honor, and added that he intended it to recall the fact that the Swedish chemist and mineralogist Berzelius vainly thought to have found in this mineral the metal *Thorium*, which he had named (1815) before its existence was really established (1828). The honor which Berzelius indirectly claimed in the supposed discovery of a new element was an empty one in this instance.[1]

As Dana appropriately remarks (*System Mineralogy*, p. 529), "there is a sneer at the great Swedish chemist in the name which should have occasioned its immediate rejection." If the word were correctly formed, so as to express what Beudant intended that it should, it would have been *Cenotime* or *Cenotimite* : hence the name, as he writes it, fails to convey the implied meaning. Dana has accepted the name *Xenotime*, as he explains, because it "may be

[1] "Conformément aux principes que nous avons adoptés, nous luis avons imposé un nom particulier, qui rappellera que le phosphate d'Yttria a été pris pour l'oxide d'un métal nouveau auquel on avait donné le nom de *Thorium*, apliqué aujour d'hui au métal découvert dans la Thorite." —*Traite de Mineral.* 1832.

regarded as referring to the fact that the crystals are small, rare, not showy, and were long unnoticed."

YENITE is a name given by the French scientist Le Lievre, in 1807, to a mineral found on the Island of Elba. The name was bestowed in commemoration of the battle of Jena, October 14th, 1806, in which Bonaparte almost annihilated the Prussian army.

Apart from the fact that the name should have been formed *Jenite* or *Jenaite*, the ungenerous spirit which prompted an introduction of political feelings into scientific matters was repudiated by Le Lievre's own countrymen, as well as by the displeased Germans: the name *Ilvaite*—from the L. name of Elba—given to the mineral by Steffens in 1811, was substituted for *Yenite.*

The hereditary rivalry between the French and German nations has found expression, within the last few years, in the naming of two newly-discovered elements: *Gallium* was named by a patriotic Frenchman, only to be followed by *Germanium* a short time after.

8. Naming minerals after localities is by no means an innovation, as the following examples will show:—

MAGNETITE.—About 400 B.C. the Greek term *λιθος Ἡρακλεια* was used by Plato to designate a mineral with magnetic power. Pliny quotes it as *Heraclion.* Probably it was named after Hercules (Herakles) in intimation of its strength (*lapis Herculeus* was used in the sixteenth century), rather than after the town of Heraclea in Lydia. Pliny claims that it was named after a shepherd, its discoverer.[1]

Later on, Dioscorides a. o. use the term *λιθος μαγνης*, describing a magnetic stone supposed to have come from *Magnesia,* a portion of Thessaly. *λιθος μαγνητης*, used by Dioscorides also, referred to soapstone or talc, so far as can be determined. (Dana and Pape.) The name reached Germany in the period of M. H. G. and took the form of *aget-stein* or *agt-stein.* It was applied rather indiscriminately, and apparently to amber by preference. The latter attracts small bits of paper and wool, etc., after having been subjected to friction.

[1] "Sideritin ab hoc alio nomine apellant, quidam Heracleon. Magnes apellatus ab inventore (autor est Nicander [about 150 B.C.]) in Ida repertus est." . . . "Invenisse autem fertur, clavis crepidarum et baculi cuspide hærentibus, cum armenta pasceret."

The Gr. *μαγνης* entered L. as *magnes,* thence passing into It. *magnete,* Sp. *magnetico,* Fr. *magnetique,* M. H. G. *magnes,* H. G. *magnet,* Sw. *magnet,* O. Engl. *magnes,* Engl. *magnet.*

> " On th' other syde an hidious rock is pight
> Of mightie magnes-stone."
>
> —*Spenser*, 1552-1559.

COPPER was obtained by the ancient Greeks from the Island of Cyprus. Homer speaks of it (880 B.C.) as *χαλκος*; and qualifies this term, which meant ore, bronze, metal or copper, by giving its color as *ἐρυθρος*=red. Later on the same name was applied to *iron,* and then the distinction *χαλκος Κυπριος*=Cyprian metal, was made, in order to avoid confusion. In L. the word *aes* is equivalent to the Gr. *χαλκος*; and the copper became known as *aes Cyprium.* (Pliny a. o.) By the end of the third century the word *aes* was dropped, and the descriptive adjective *Cyprium* evolved into the noun *cuprum.*

The alchemists gave copper the name and sign of *Venus. Κυπρις* is an old poetical name for Venus, used by Euripides (450 B.C.) a. o., and the Island of Cyprus was devoted to her cult.

From L. *aes Cyprium* and M. L. *cuprum* have sprung: A.-Sax. *cyper,* O. H. G. *Kuphar,* H. G. *Kupfer,* O. Fr. *cuyvre.* Fr. *cuivre,* Sp. *cobre,* Sw. *coppar,* D. *koper,* O. Engl. *coper,* Engl. *copper.*

> " Lyke as to a true syluer grote a false coper grote," etc.
>
> —*Sir T. More*, 1478 to 1535.

TURQUOIS is really an adjective=*turkish* (from Turkey), and is taken directly from the French. In Middle German the word was *turggis;* M. H. G., *turkoys.* In the middle of the sixteenth century this changed to *Türckis* and *Türkis.* The Sw. is *turkos.* N. L. forms are: *Turcois, turcosa, turchesia;* It., *turchesa, turchina;* Sp., *turquesa;* O. Fr., *turquoise;* O. Engl., *turques;* Engl., *turquois.*

> "I bequeth a ryng of gold, sette w^t a turques, a dyamaunt, and a ruby." —*Fabyan*, 1512.

9. There are a few names, familiar to almost every one, that have an exotic sound, foreign to that of the languages which have principally furnished the material for mineralogical nomenclature :—

TOURMALINE—also known as *Turpelin* during the last century, is derived from the Cingalese *turamali.*

BORAX, a universally-known word, comes from the Ar. *buraq*.

CORUNDUM (Fr. *corindon*) owes its form to the Hindostan *Kurand*.

KAOLIN, the well-known porcelain-earth, was first mainly obtained from *Kau-Ling*, in China: whence its name.

A MONTH IN PALÁWAN.

BY J. B. STEERE.

THE island of Paláwan, or, as it is more frequently called by the Spaniards, Paráqua, is classed as one of the Philippine group. It runs from the northeast to the southwest, and is something over 250 miles long, while it hardly averages 20 miles in width. It fronts the China sea on the west, and the Sulu or Mindora sea on the east. It is distantly connected on the north and east with the other Philippines—through the Cuyos with Panay, and through the Calamines with Mindoro and Luzon; but it is much more closely connected on the south by Balabac and other small islands with Borneo. It is mountainous and heavily timbered, and but thinly inhabited, the native population being estimated by the Spaniards at ten or twelve thousand. The native people are of at least two races, Malays and Negritos. The southern end is chiefly inhabited by people of Malay race, to whom the Spaniards give the name of their hereditary African enemies, Moros or Moors. They are Mahometan in religion, and this, with the presence of their priests, has kept them more or less united, and perhaps a little in advance of the northern tribes. The northern part is inhabited by savages of Malay race, living in small, scattered tribes, and of Negritos—wooly-haired black people—living in much the same state, and apparently amalgamating with the Malays. The Spanish have had some small settlements of Christian Indians from Luzon, at the north, for some time, and for fifteen or twenty years have been forming a convict town at Puerto Princesa, on the east coast, and near the middle of the island. This now numbers some twelve or fifteen hundred inhabitants, mostly criminals shipped there from other parts of the colony. This is the capital and residence of the Spanish governor and other officers. Within a few years the Spanish have also formed small military settlements on the west coast.

Our party from the University of Michigan reached the island about the first of September, 1887, in the midst of the rainy season, but as the showers usually came in the afternoon, we were able to do a good deal of hunting and other collecting in the forenoon, while we spent the afternoon in skinning and preparing the collection of the morning. From lack of roads or other means of communication, our work was done chiefly on the low, heavily-timbered peninsula on which the town is built. We also did some work across the bay, along the little river Iguahit, and about a village of natives who called themselves Tagbaunas. The collections made by us during the four weeks of our stay numbered about seven hundred birds of some one hundred and twenty species; thirty mammals of five species; thirty amphibia of three species; one fresh-water turtle; fifteen lizards of six species; fifteen snakes of nine species; three hundred butterflies of thirty species; a few small and inconspicuous beetles, scorpions, and centipedes; ten or twelve species of corals from the shallow waters of the bay, and a large number of fine land and tree shells.

The island has been considered to belong to the Philippine group zoologically as well as politically—Mr. Wallace dividing the Indo-Malayan sub-region into three divisions: Java, Sumatra, Borneo, and Malacca, and the Philippines. Our work would seem to show that Paláwan is much more nearly allied zoologically to Borneo than are the other islands of the group, and probably more nearly allied to Borneo than to the other islands. This state of things seems to be especially shown in the mammals, in which the island is much richer than the rest of the group. It possesses, in common with Borneo and the other Philippines, the common gray monkey, *Macacus cynomolgus*, a species of Tupaia, one of squirrels, a wild hog, and one or two species of civet cats. In addition to these we found the manis or pangolin and the binturong, both common to Borneo, but wanting in the rest of the Philippines. We also became satisfied of the existence of a porcupine, *Hystrix*, a large round-tailed flying squirrel, *Pteromys*, and of a small species of the Mustelidæ, with powerful and unpleasant odor. Besides these Bornean forms there is probably also a species of tree-cat, Felis, and a mountain goat in the island. These species rest on the evidence of Spaniards and half-breeds capable of observing, and worthy of credence. In addition to these the savages declare that there is an orang outang in the interior. The mammals common to the rest of the Philip-

pine group and wanting in Paláwan are also noteworthy. Deer, present everywhere else, are said not to exist, and we saw no signs of them. The kaguan or Galeopithecus, one of the most common Philippine mammals, is apparently absent here. These facts seem to show that Paláwan has received its animal population from Borneo at a different time and through a different route than the rest of the group. The intervening island of Balabac possesses the common monkey, the wild hog, a true squirrel, a porcupine, an ill-smelling weasel; lacks the manis of Paláwan, but has a diminutive deer, *Tragulus*, common to it and Borneo.

In its birds Paláwan also shows its closer connection with Borneo. Among Bornean forms which do not seem to have made their way into the other Philippines, are the two beautiful genera of greenlets, *Iora* and *Phyllornis*; a three-toed woodpecker, *Tiga*; a true pheasant, *Polyplectron*, closely allied to the beautiful glass pheasants of Borneo and Malacca; and a frog-mouth (*Podargus*) bird, allied to the goat-suckers, but with the mouth parts (beak) heavy and hard. The Bornean look of our birds is quite apparent when we compare them with birds from the other islands, and careful study will probably show many more instances than those above mentioned.

Sun-birds, kingfishers, cuckoos, and swifts were especially abundant in species and individuals.

About September 20 we began to find large numbers of titlarks, snipes, plovers, and sand-pipers, and concluded that this must be the advance of the fall migration from the northwest. The only arboreal species which seemed to arrive at the same time was one of the warblers, Sylviidæ.

We undertook to make as careful notes of habits, height of flight, and feeding, character of foods, etc., as was possible in our hurried stay. Tropical species of birds seem to be much more nearly limited to specific kinds of food than those of temperate countries. A careful examination of the stomachs of our collection showed that some species lived entirely upon ants, others upon centipedes, others upon some special kind of fruit, etc., etc. The three-toed woodpecker noted above lives exclusively on ants, and these possibly of a single species—at least all of the same color; while a four-toed species (*Chrysocolaptes*), much like the three-toed one in size and color, lives on the common larval food of the family. One splendid long-tailed cuckoo, with beautiful metallic-blue coloring, bare spots of vivid crimson about the eyes, and immense light-green beak,

were exactly alike in the sexes with the exception that the male had eyes of cherry red, while those of the female were yellow—and this uniformly so through six or eight pairs procured. We shall take means for a more thorough study of the mammals of the island than was possible during our short stay. We have come on to the port of Zamboanga, in the island of Mindanao, and purpose to make a collection of the same character here.

INTELLIGENT SELECTION.

BY CHARLES MORRIS.

WHY do not distinct species of animals and plants appear as a consequence of man's selection and preservation of varieties? This is a question which has been asked more often than it has been answered, and which yet remains to some extent an open query. Among domesticated animals—dogs, pigeons, and a few other species in particular—the varieties produced by selection have been very numerous and well marked, yet they still remain dogs, pigeons, etc., and there is no generally accepted evidence that a new species has ever been produced by this method.[1]

Yet though much has been said on this question, it is by no means exhausted. There is one important circumstance which does not appear to have been considered, and which therefore gives warrant for a further review of the subject. It is not sufficiently borne in mind that the production of, and experiments on, varieties of animals and plants has been left almost entirely in the hands of ordinary industry. Science has come in to examine the results, yet has had little to do with the experiments. These have been governed almost solely by pecuniary considerations; yet it must be admitted that what may be admirably calculated to make money may be valueless to science, and that had a long series of experiments been conducted for scientific purposes alone, the results must have

[1] It is necessary to state, however, that many scientists hold that new species, and even genera, have been produced in domesticated animals. The carrier pigeon, for instance, is looked upon as a well-marked and persistent species, while variations in the dentition of dogs, of generic value, have been observed. Changes of this character are of the kind which it is important for scientific observers to endeavor to hereditarily transmit, and render permanent.

been widely different from those that have appeared, and may have been far more significant. That distinct species could have been thus produced is quite within the limits of probability.

We have named this process Intelligent Selection, as distinguished from Natural Selection. Yet in reality, though the former is conducted by man's intelligence instead of by the unaided influences of nature, there is no actual difference of principle between the two methods of selection. The changes which proceed with interminable slowness in the one case are greatly accelerated in the other; yet while Natural Selection is the work of nature unaided, Intelligent Selection is but the work of nature aided. The influences tending to favor and preserve variations which nature employs occasionally and slowly, are frequently and rapidly employed by man, and thus animals and plants exhibit wider variations under man's hands in years than they do under nature's hands in centuries. Yet the principles which control the preservation of varieties are probably much the same in both cases, and all that man has done has been to accelerate the process.

If, as is ordinarily believed, no new species or genera have been produced by man, though such have abundantly appeared in nature, a marked discrepancy would seem to exist between the action of Intelligent and Natural Selection. But it must be borne in mind that nature produces an extraordinary number of varieties as preliminary to every new species that appears. Ordinary variations are superficial, and of non-specific value. Variations in specific characters are probably of rare occurrence, and their preservation yet rarer. Possibly they only arise as resultants of a long series of minor variations in the same general direction. If such be the case it is not surprising that the superficial variations with which man has to deal seldom or never accumulate into characters of specific value—particularly in the lack of scientific direction.

Yet that species have not been produced by man is more an assertion than a demonstrated fact. If we take the varieties of dogs, for instance, such wide differences in size, form, and habits appear that many of these varieties, if found in nature, would be at once accepted as well-defined species. Yet it is declared that these distinctions are but artificial, and would very quickly disappear if the dogs were restored to nature. This assertion is ordinarily quietly accepted, yet it remains but an assertion. No one has ever proved

it. The fact is that while such dogs as preserve their natural instincts and conditions with little impairment might regain their original feral condition, those whose variation is extreme would simply die out. They could not survive in the struggle for existence if immediately removed from the artificial conditions to which they have been accustomed. Yet if two widely different varieties of dogs were slowly restored to nature, being protected and fed until they had learned the art of self-preservation without man's care, it is by no means improbable that they might retain their peculiar characters of form, habit, and adaptation to particular food, and if interbred for a considerable period might continue to interbreed. Though there is no proof of this, there is no disproof. It is an open problem, which can be settled only by experiment. The statement that all variational differences would disappear if any of the domesticated species were restored to feral conditions, is an unproved assertion, which cannot be verified without a much wider series of scientifically-directed experiments than have yet been made. Dozens of problems of this kind are settled in men's minds. Very few of them have been settled in fact.

It will be of interest, in this connection, to consider what has actually been done by Intelligent Selection, and the influences which have controlled its results. A mere glance at the subject shows us that industrial and pecuniary considerations have almost solely been at work. Among trees, for instance, the effort has been to select fruits of large size, agreeable taste, and early or late maturity. Among flower bushes, bright colors and odd shapes of petals, with variations in the size of the flower and its number of petals, have been the ruling considerations. Commercial value has been the sole thought, and superficial variations only have been preserved. A scientist would have watched for changes in the character of the pistils and stamens of the flowers, and if such appeared, by their careful preservation might in time have produced undoubted new species. Yet no extended series of experiments from this scientific point of view has been made, so far as the present writer is aware. Such changes may be of comparatively rare occurrence and inconspicuous, yet there can be little question that they occasionally arise, and they may be as susceptible to selective processes as any other variations.

Among animals the purposes aimed at by trainers vary in the case

of almost every species, yet they are, as a rule, all industrial. In the horse, for instance, the properties selected are speed, gracefulness of form, size, endurance, muscular strength, etc. In cattle milk-giving properties and delicacy of flesh are sought. Sheep are selected for fineness of wool and palatableness of meat. In swine pork-yielding powers are the sole consideration. Among domesticated birds, egg-laying powers are the main consideration in the hen, while in all these birds delicacy of flesh is particularly considered. Beauty of plumage and peculiarity of form are also favorite selective properties, and particularly in the case of pigeons, which have yielded extraordinary diversities in this respect.

In all these experiments but two considerations have ruled: the commercial value of the product, and its adaptation to man's pleasure. The money it will bring, and the enjoyment it will give to man's senses or his appetite, have been the overruling influences in the selection of varieties of plants and animals, and if any variation approaching specific value has been preserved, it has been through chance rather than design. The characters sought for have been superficial ones only, and in consequence superficial varieties mainly have been obtained.

Had this long series of experiments in selection been conducted by scientists, and for scientific purposes only, the results must have been widely different. The commercial value of the product might have been much less; the scientific value must have been much greater. Among the innumerable variations in form and character of animals and plants which incessantly appear, there must be some of more essential and less superficial significance than others. Only the eye of a trained scientist could discriminate between these, and by persistent selection of such variations, and neglect of all others, there can be no doubt that the question as to whether species can be produced by intelligent selection would have been far nearer settlement than it is now.

In the case of only a few animals has the consideration in selection been other than to aid in the support or to administer to the pleasure of man. Of the species in which wider purposes have ruled, the principal is the dog. In this animal there has been little tendency to subvert the natural instincts. Most of the domesticated species have been so diligently cared for by man that they have lost the ability to care for themselves, and the intelligence which they

possessed in their wild state has disappeared, and been replaced by no new intelligence. There are no more stupid animals on the face of the earth than the cattle and sheep of the farm. The hog and the horse are less so, the former because he has preserved some degree of feral independence, and the latter because his duties have required some degree of intelligence.

But the dog has protected instead of being protected by man, and has thus, except in some special varieties, retained its natural intelligence. And its employment under man has been such as to develop and preserve a new intelligence. The dog has been for ages man's companion. Its natural instincts have been retained, while upon them have been laid new instincts of the same general character; and its powers of observation have been very greatly widened and sharpened. It has been in contact with men mentally, and its own mental powers have been developed thereby. And finally selection, while devoted largely to peculiarities of form, has been yet more largely devoted to peculiarities of habit—to intellectual characteristics. Intelligence has been selected in dogs, and in this alone of all domesticated species.

Of the other species on which selection for intelligence might have been practiced, preventive circumstances have hindered. The cats are natively as independent as the dogs. But the domestic cat is only in a minor sense a tamed animal. In its reproductive habits it is a wild creature. In consequence selection has been almost impossible, and very few varieties of cats have appeared. Such as exist, indeed, are probably due to natural, not to intelligent selection. The monkeys, and particularly the higher apes, would be remarkably well adapted to selection for intelligence, but unfortunately they do not breed well in captivity. The anthropoid apes indeed, not only do not breed, but have never lived long in captivity, so that this promising field of selective experiment is practically closed. What results might arise could a fertile domestic race of orangs or chimpanzees be produced, it is not easy to decide. The marked intelligence and teachableness displayed by individuals, with no hereditary powers but those derived from a wild-woods life, is significant of remarkable developments could they be made to breed in captivity. It would not be easy to give them new vocal organs, and teach them to talk, but by long-continued selection their brains might be developed in size and power until they became the equal in intelligence of some of the lowest savage tribes of man.

Dogs are the only species which promise good results in selection for intelligence, and it is highly desirable that experiments on them, with this purpose in view, should be made. The desultory selection which has been practiced has given excellent results in this direction, while many instances of high intelligence in individual dogs have appeared. But no breeder seems to have made it his business to make this intelligence the basis of his selective operations, though it has been done to some extent without design, in the effort to preserve high-bred varieties. It is desirable that a series of scientific experiments with this object in view should be undertaken, the intelligence of individual dogs being awakened as fully as possible, and the same training applied to the offspring of these dogs during a number of generations. The result could scarcely fail to be of interest and importance.

In fact it is desirable that scientists should give some attention to the general subject here considered—that of intelligent selection of varieties of animals and plants for other purposes than those of commerce. Many results not now dreamed of might thus be attained, and the problems of the origin of species and the limits of animal intellect be brought nearer to solution. When such extraordinary results have been produced by the chance methods of selection of superficial traits so far practiced, the adoption of scientific methods and the selection of more significant characteristics would very likely yield varieties of the utmost interest and value to science.

EDITORS' TABLE.

New popular scientific journals are appearing or are announced from time to time. We have received the first number of the *American Geologist*, which is published at Minneapolis. As its title implies, its field embraces geology and all the immediately allied and subordinate sciences. Its editorial corps embraces some of our most able and accomplished geologists. It deserves success, and our country is large enough to ensure this, if its people are sufficiently interested in the subject to subscribe for it.

Another important journal is announced by a New York company, to be called *Garden and Forest*, which is to be a Journal of Horticulture, Landscape Art, and Forestry. Its editors are to be Professors C. S. Sargent and W. G. Farlow, of Harvard, and Professor A. S. Packard, of Brown. This journal is designed for a comparatively wealthy constituency, and will not be, apparently, exclusively scientific, although its editorial corps is highly so.

So far as the publication of new scientific journals is concerned, we cannot have too many of them if they are well backed or sustained, financially. Unless this be the case, however, we regret the loss of time and labor which they cause to their projectors and contributors. Experts in science are not sufficiently numerous in this country to enable us to spare any of them for popular work, unless they are so compensated as to prevent any actual loss to their scientific efficiency. It may be safely assumed that every really meritorious work of a specialist which is produced in this country will have ten translators, even if his work reaches the American public by way of Europe, before it is appreciated. It is easier to compile than to produce.

We have had some experience of the financial aspect of the question. The perils are many and various. The NATURALIST, although now in its twenty-second year, has escaped shipwreck by little less than a miracle several times. But the maxim, "while there is life there is hope," has been as often verified, and the vigorous constitution which comes of—modesty forbids us to say just what—has triumphed, while many of our contemporaries have "joined the majority"—of popular scientific journals.

RECENT LITERATURE.

CLAYPOLE'S "THE LAKE AGE IN OHIO."[1]—The course of the terminal moraine in Ohio is westward from the New York line to about the middle of the State, after which it swerves south and southwest so as to cross into Kentucky. "The ice," says our author, "*dammed the Ohio River above the site of Cincinnati*," forming a sheet of water which he names "Lake Ohio." As the banks of the Ohio are 400 to 500 feet high at Cincinnati, the ice must have been thicker than this. If assumed at 500 feet, the rim of the ice would be 365 feet above the level of Lake Erie. The entire south of Ohio, a large portion of West Virginia, and portions of Kentucky and Pennsylvania, including the site of Pittsburgh, must thus have been under water, forming a lake some 400 miles by 200. Professor Claypole, from the mass of the moraine, and other reasons, assigns considerable time to the life of this lake before the ice-dam gave way, at first to be repaired every winter, at last utterly.

When the glacier, in its further retreat, had crossed the water-shed, the waters formed by its melting, unable to escape towards the north, formed a series of smaller lakes in what are now the valleys of rivers flowing into Lakes Erie and Ontario. As a consequence of the still farther retreat of the ice, these lakes became confluent, the water was drained away from those that lay highest, and carried off through the lowest water-gap, paving the way for the formation of Lakes Erie and Ontario, which at one stage formed a single vast sheet of water.

For some time a narrow ice-dam stretching across the St. Lawrence valley held the waters of this great lake at a level of 700 feet above the sea.

Professor Claypole traces the various steps of the ice retreat and lake formation with much care, and illustrates his argument with four maps. W. N. L.

RECENT BOOKS AND PAMPHLETS.

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Kittl, E.—Ueber den miocenen Tegel von Walbersdorf. Sep-abd a. Band I. d. Ann. d.k.k. naturhist-Hofmuseums. From the author. —Der geologischen Bau der Umgebreng von Wien. 1887. From the author.—Beiträge zur Kenntniss der fossilen Säugethiere von Maragha in Persien. 1. Carnivoren. Sep. abd. a Band II. d. Ann. d.k.k. naturhist. Hofmuseums. 1887. From the author.

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[1] The Lake Age in Ohio, or Some Episodes during the Retreat of the North American Ice-sheet. By E. W. Claypole, B.A., B.S.C. Edinburgh: Maclachlan & Stewart. 1887.

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GEOGRAPHY AND TRAVEL.[1]

ASIA.—CAREY'S JOURNEY IN TURKISTAN.—The enterprising English traveler, A. D. Carey, who in May, 1885, left Simla, furnished with a passport from the Chinese Government authorising him to travel in Turkistan, China, and Tibet, has returned to London, and on November 28th read an account of his journey at a meeting of the Royal Geographical Society. His route lay through the Kulu and Lahoul valleys and across the Buralacha Pass to Leh, where he was joined by Mr. Dalgleish, his Turki interpreter and assistant. From Leh to Turkistan his route lay through the uninhabited tract of Tibet lying between Rudockh and Polu. He considers the route useless for trade purposes, since it runs for some distance at a height of 16,000 feet, is impracticable for luggage animals between Sulphur-Horse Pass and Polu, and enters Turkistan at too distant a point from Yarkand and Kashgar. The Chinese authorities at Kiria were ignorant of the existence of this route from India, and were thrown into consternation by the traveler's arrival. Within the area of irrigation of the Kiria river agriculture flourishes, and fruit, cereals, vegetables, and trees are abundant. The travelers met with great respect here. A good bridged road connects Kiria with the busy manufacturing town of Khoten, where carpets, silk, felt, and copper and brass vessels are made. The population is said to be about 30,000, but it was evidently once much larger, as ruins of an old wall which included the sites of the present separate Mohammedan and Chinese towns can be traced. The travelers followed the Yurangkash to its junction with the Karakash, and then proceeded along the wider stream (the Khoton) to the Tarim. After visiting the towns of Shah Yar, Kuchar, Karashahr, and Kurla, Mr. Carey pushed on to the Lob-Nor district. Miserable poverty seems the main characteristic of the Mussulman Turki-speaking natives of the Lob district, against whom their neighbors higher up the Tarim are much prejudiced. On April 29, 1886, Mr. Carey started for a pass over the Altyn Tagh, but the guide lost his way. After being compelled to burn the ridge-pole of a tent for fuel, the less barren valley of Bokalik was reached. After wandering in the mountains, guided only by a compass and sextant, for eighty days without seeing a human being, the party came upon several hundred armed pilgrims, and found that they were between the Kuen-Lun and Khokosili ranges, just south of the Angirtakshia Pass, and south of the Naichi valley, the point aimed at. Here much difficulty was experienced in procuring food,

[1] Edited by W. N. Lockington, Philadelphia, Pa.

as the supplies of the natives had run short. In the course of a journey to a place called Hoiduthara in quest of barley, Mr. Carey and his Tartar (Daspa) were the recipients of great kindness from a young Lama, who, observing the exhausted condition of the pair, rode to the town and ten miles back to bring them food. After 37 days the two rejoined Mr. Dalgleish with supplies.

Hajjar, the residence of the chief of the Thaichinenr Mongols, was next reached. Our traveler characterizes the Mongols as timid and poor, and so accustomed to being cheated by Chinese that they cannot believe anyone will treat them fairly. Makhai, the Saithang plain, and Sachu were the next points—the last a Chinese town built of sun-dried bricks, mud, and timber. At Hami, a Belgian and two Russians were found. At this point the travellers turned westward, and after passing by Pichan, (the frontier post of Kashgaria under Yakule Bey) and Turfan, made an excursion to Urumtsi, the headquarters of the Chinese Government of Turkistan. They then pushed on to the previously visited town of Kurla, and returned to Ladakh via Kuchar, Aksu, and Yarkand.

Mr. Carey has thus visited almost every important place in Chinese Turkistan except Kashgar, and he states that it is for the most part purely desert, the only really good strip of country being in the west, and composing Kashgar, Kargalik, and Yarkand. The Chinese give complete religious toleration, repress crime well, and maintain a high prestige.

THE TARIM DISTRICT.—The Tarim river had, in October, 1885, a depth of three to five feet, and a width of about 135 yards at the confluence of the Yarkand and Khotan. In summer the depth and width, as stated by the natives, and proved by the state of the river-bed, are thrice the above. It is only in summer that the Khotan-daria flows into it. The Tarim thus seems to be navigable for steamers from the confluence of the Yarkand and Khotan to the Lob-Nor.

The map in a recent number of the *Izvestia*, embodying the results of the fourth journey of General Przewalski (Prejevalsky) in Central Asia, shows that the depression of the Lob Nor must not be confounded with the Eastern Gobi, which latter is more elevated, and falls by a steep terrace towards the depression of the Lob-Nor. Thus the Tarim region is a depression of the high plateau of East Asia, limited on the east as well as on the north, west, and south.

THE MOUNTAINS OF SIAM.—Mr. J. McCarthy, who has for seven years been superintendent of surveys in Spain, states that the chain of mountains which runs on the west in an unbroken range to Singapore, has peaks of 7,000 feet between Burmah and Siam, while one peak in the Malay Peninsula reaches 8,000 feet. The eastern range,

which forms the watershed between the rivers flowing into the Chinese sea and the Meinam Kong (Mekong), has peaks of 9,000 feet. Another range, which leaves the western range near Chingmai (Zimmé), forms the watershed between the Meinam and Meinam Kong valleys. Famous salt wells exist in this range at the source of the eastern branch of the Meinam.

AFRICA.—M. DOULS' ADVENTURES IN THE SAHARA.—M. Douls, disguised as a Mussulman, landed from a Canary Island fishing boat at a point between Cape Bojador and the Rio de Oro. The first Moors he met suspected him, and made him a prisoner, but by persevering in his rôle he was finally admitted as a brother into the tribe, which proved to be a section of the terrible Ulad Delim, the robbers of the Western Sahara. For five months he wandered with them, exploring the desert of Uaran and Djuf, the great depression of the Sahara. In March last he was at Tendûf, the great slave market of the Northern Sahara. This oasis has greatly increased in size since Dr. Lenz's visit in 1880. Taking leave of the nomads at Glimin, he proceeded across the Atlas through the country of the Berbers of Sus to the city of Morocco. Here he was suspected and thrown into a dungeon, but was fortunately liberated through the representations of Sir Kirby Green, the English ambassador, who reached the town the same evening.

LIEUT. WISSMANN'S SECOND JOURNEY ACROSS AFRICA.—Lieut. Wissmann has returned from his second expedition across Africa. His route was from Angola to Luluaburg in the empire of the Muata Yambo, thence to the Lubi, which, after an excursion to the country of the Benangongo, they followed to its confluence with the Sankaru; thence eastward through a vast belt of primeval forest inhabited by Batetela and the dwarfish Watwa; then through the country of the Beneki to the Lomami and Nyangwe, whence he reached the Eastern coast by way of lakes Tanganyika and Nyassa. The slave trade is flourishing east of the Saukura, the Bassonge and Bassenge being the chief offenders, often supported by slave-traders. The country of the industrious Beneki was entirely devastated.

AMERICA.—SUBMARINE VALLEYS OF THE CALIFORNIAN COAST. —Prof. Geo. Davidson (*Bull. Cal. Acad. Sci.*) describes the submarine valleys discovered off the Pacific Coast of the United States. Within forty or fifty miles of the shore south of Cape Mendocino the plateau of the Pacific reaches a depth of 2,000 to 2,400 fathoms. There is usually a marginal plateau ten miles wide to the 100 fathom curve, beyond which the descent is sharp to 500 or 600 fathoms. In this marginal plateau several remarkable valleys have been discovered. One of these is in Monterey Bay, heading to the lowlands at the bend of Salinas river; and another off Point Hueneme, at

the eastern entrance of the Santa Barbara channel; there are one or two off the southern point of Carmel Bay, while the deepest one reaches far into the bay. Near Cape Mendocino, just north of a submarine ridge extending from Point Delgada to Shelter Cove, is a deep valley which breaks through the marginal plateau and runs sharply into the immediate coast line. The head of this valley, at one and one quarter miles from shore, is 100 fathoms deep; where it breaks through the 100 fathom line it is 400 fathoms deep. The slopes of the sides are very steep. Midway between this and Point Gorda is another valley 150 to 300 fathoms deep, reaching 520 fathoms where it breaks through the 100 fathom line. Another valley between Point Gorda and Cape Mendocino is 450 fathoms deep at a point six and one half miles southwest by south from the cape. This valley is a wide one, with green mud at its bottom.

Explorations on the Yukon.—Dr. G. M. Dawson and party left Victoria in May last with the object of exploring the tributaries of the Upper Yukon. He proceeded up the Stikine River as far as Dease Lake, and when, on June 18th, the ice broke up, went down the Dease River and into the forks of the Dease and the Liard. Mr. McConnell here separated from the party with the purpose of descending and surveying the Liard and Mackenzie, and will probably winter at Fort Simpson, on the latter river. Dr. Dawson went up the Liard and Frances Rivers to Frances Lake, which drains into the Liard; then made a portage of fifty miles to the Pelly River, which they descended to the confluence of the Pelly and Lewis; and then ascended the Lewis, crossing the Chilcot portage to the head of Lynn Canal.

Geographical News.—Mr. Cuthbertson has reached the summit of Mount Obree, one of the culminating peaks of the Owen Stanley range. He makes it only 8000 feet high, instead of 10,246, as was determined by angular measurements taken by the *Rattlesnake* expedition. He states that at 2,500 feet above the sea he passed the point reached by Messrs. Hunter and Hartmann.

The population of New Zealand in March, 1886, exclusive of Maoris, was 578,482, an increase of 33,549 over that of 1881. The figures include 4,527 Chinese, only 15 of whom are women. The Maoris number 41,969, and 2,254 half castes living with the Maoris.

M. Marche has paid a visit to Saïpan, in the Marianne Group. No trace of a volcano or volcanic rocks, such as have been reported, was found, and Tapochas, the highest peak, was by barometrical

measurement found to be 1,345 feet high instead of 2,000, as formerly supposed. The other hills reach 600 to 700 feet. There is very little fresh water.

The Danish Government has decided to despatch an expedition to Iceland this coming summer, to effect hydrographical measurements. Great fiords and waterways still remain unmeasured.

The "Statistique de la Superficie et de la Population des Contrees de la Terre," by M.E. Lavasseur, gives the following table of areas and populations for 1886:—

	Area million of sq. kilometres.	Population. In millions.	Density of sq. kilometre.	Ratio to total.
Europe	10.0	347	34	23.4
Africa	31.4	197	6	13.3
Asia	43.0	789	19	53.1
Oceanica	11.0	38	3.5	2.6
North America	23.4	80	3.4	5.4
South America including Australasia	18.3	32	1.7	2.1
	136,1	1,483	10.9	100

Nearly two-thirds of mankind are concentrated in about eleven millions of square kilometres, viz.: West Central and South Europe (245 millions of inhabitants, 3.5 millions of kilometres); the Anglo-Indian Empire (254 and 3.6); and China, Manchuria and Japan (430 and 4).

Dr. Krause has arrived at Accra on the Gold Coast absolutely without means, having been compelled to leave his collections and baggage behind through the opposition of the natives.

M. J. Thulet, from observations taken on the *Clorinde* combined with those of Mr. Buchanan on the *Challenger*, has prepared a series of longitudinal and transverse sections of the Gulf Stream. It is like a river, and has a steeper slope towards the United States than towards the ocean. The great St. Lawrence current, coming from between Cape Breton Island and St. Paul, collides with the Gulf Stream, lessens its speed, and leaves as a sort of submarine delta the banks extending along the United States coast to the great bank of Newfoundland. The eastern polar current skirts Newfoundland, strikes the Gulf Stream at right angles, and since its waters are a little *lighter* than those of the Gulf Stream, mixes with them, and almost entirely arrests them. The cooled waters spread out in a general north-easterly direction, but there is no longer any definite current.

The researches of General Tillo on temperature have led him to conclude that the continents are, as a whole, 3° cent. colder than the oceans between the latitudes of 90° N. and 50° S. The New Continent is 3° colder than the Old; and the Atlantic 2.6° colder than the Pacific. The northern hemisphere contains 14 per cent. of the cold regions, 35 per cent. of temperate, and 51 per cent. of hot regions. Dr. Supan's estimate, reached by a different method, gave 15, 32 and 53 per cent. for these regions.

GEOLOGY AND PALÆONTOLOGY.

The Vertebrate Fauna of the Puerco Epoch.—I have recently revised my material representing this fauna, and have added eighteen species to those already known. One of these belong to a new genus, viz.: Onychodectes, allied to Conoryctes (Creodont).

The Puerco formation lies on the Laramie in North Western New Mexico and South Western Colorado, and is largely covered by the Wasatch Eocene in both regions. It was discovered by the writer in 1874, at its eastern outcrop of about 500 feet thickness, and was identified by Endlich and Holmes in Colorado, in 1876, where the thickness reaches 1000 to 1200 feet. On the San Juan river, its thickness is 700 feet, while at its western outcrop, south of that river, its thickness is 800 or 900 feet. While the formation possesses lithological peculiarities, no clue to its importance in geologic chronology was known until the discovery of vertebrate remains was made in 1880, by Mr. David Baldwin. With the evidence derived from this material the writer has been able to interject into the series of epochs of geological time a period which must have possessed many peculiarities, and which differed in such important essentials from those which preceded and from those that followed it, that an immense interval between them is proved to have existed, such as had not been previously suspected. The rich fauna which it contains displays characters which indicate others yet to be discovered before connections with other epochs both prior and subsequent can be known.

The vertebrate fauna includes up to the present date one hundred and six known species. Four species of Mollusca have been discovered, which have been determined by Dr. C. A. White, of the U. S. National Museum. They are *Unio rectoides* White; *Helix adipis* White; *H. nacimientensis* White, and *Pupa leidyi* Meek. The first named is found in the Wasatch, and the last in the Laramie; the two other species are peculiar. Besides these, the only other indications of organic life at that period is petrified wood of undetermined trees, which is quite abundant.

The character of the vertebrate fauna is indicated by the following table:

Reptilia	12
Crocodilia	3
Testudinata	5
Rhynchocephalia	3
Ophidia	1
Aves	1
Mammalia	93
Marsupialia	11
Bunotheria	52
Tæniodonta	3
Creodonta	49
Taxeopoda	28
Quadrumana	4
Condylarthra	24
Amblypoda	2
Total	106

In 1874, the writer advanced the proposition that the ancestors of modern placental mammalia would be found to be "plantigrade pentadactyle bunodonts." This anticipation was partly realised in the fauna of the Wasatch epoch subsequently discovered, but is completely so, in the characters of the mammalia of the Puerco epoch. All the placentals, and probably the Implacentals also, were "plantigrade pentodactyle bunodonts." More than this, the placentals nearly all present the primitive type of dendition of the maxillary series, since the superior no less are nearly all of the tritubercular type. But four species out of the eighty-seven placentals are quadritubercular. In the inferior molars the tuberculosectorial, or quinquetubercular type of dertition is extensively prevalent, but not so generally so as the superior tritubercular. Thus of the eighty-seven placentals sixty-four present the primitive type.

In its relations to other faunæ, the Puerco is totally distinct as to species. No species comes to it from an earlier epoch, and none continued unchanged after it. Of genera not widely distributed in time, one of lizard-like Rhynchocephalia, Champsosaurus, comes over from the Laramie, with a genus of tortoises Compsemys. Another genus of tortoises, Dermatemys, probably commences at this epoch, to continue through the Wasatch and Bridger Eocenes to the present time, since it still exists in Mexico. Among Mammalia, one genus only continues later, since Didymictis is found in the Wasatch and Wind-river formations. None other continues after the close of the Puerco. Not only this, but the entire family of the Periptychidæ ceased at that period. The same is true of the Amblypod family Pantolambdidæ. One of the most important features of the fauna is, however, the presence of eleven species of the Marsuspialia Multituberculata, a suborder which commenced in the Triassic age, and which terminated its existence so far as the Northern Hemisphere is concerned, with the end of the Puerco epoch. This series of animals gives a Mesozoic character to the fauna, which is not necessarily counterbalanced by the characters of the remaining types. The placentals are in all probability those which existed during the latter part of Mesozoic time, and the absence of some of the forms of the Eocene increases the weight of the impression thus produced. Thus two orders

universally present in the Eocenes, the Perissodactyla and the Rodentia, are wanting from the Puerco.

In conclusion it may be safely assumed that in the Puerco fauna, we find the ancestors of the species of Eocene and of later times. In the Tæniodonta we get ancestors of Tillodonta and probably of Rodentia and Edentata. In Creodonta we get the ancestors of the Carnivora, in the family of the Miacidæ. In the Condylarthra, we get the ancestors of the Diplarthra and Amblypoda, and in the Puerco Amblypoda the ancestors of those of the following epochs. Hence the investigation of this fauna possesses an especial interest for the mammalogist and for the evolutionist, as well as for the geologist proper.—*E. D. Cope.*

SCHLOSSER ON THE CÆNOZOIC MARSUPIALS AND UNGUICULATA.[1]—The first part of this work contains all of the Unguiculata, except the Edentata, Rodentia and Carnivora. The last-named order will form the second part. The work is an important one, in quarto form, and the first part is illustrated with five plates. This supplements the American works on the same subject and brings it up to the present time, with minor exceptions.

The present author shows throughout, his fine appreciation of the points of structure of the vertebrate skeleton, and he makes judicious use of them, from a systematic point of view, although one observes, perhaps, a tendency to rather more minute taxonomic division than the circumstances warrant. The work is also characterized by a thorough acquaintance with the literature of the subject. Important additions to our knowledge are made in every department.

We can only mention here the descriptions of the little-known genera of Von Meyer—Dimylus, Cordylodon and Oxygomphius, the first two remarkable forms of Insectivora. To the Creodonta he adds the new genus Pseudopterodon, which is founded on a species of about the size of a fox (*P. ganodus*), allied to Pterodon.

Dr. Schlosser continues to exclude the Miacidæ from the Creodonta; but he has not been aware that Scott shows that the lumbar zygapophyses have the characters of the other members of that order or sub-order. For some unaccountable reason he places Esthonyx in the Edentata. Numerous important additions are made to the Chiroptera, in the genera Vespertiliavus and Pseudorhinolophus.

One of the most striking discoveries recorded is the fact that the supposed canine teeth of the Lemurs of the present period are really the anterior premolars, as in the Artiodactyle genus Oreo-

[1] Die Affen, Lemuren, Chiropteren, Insectivoren, Marsupialier, Creodonten u. Carnivoren d. europäischen Tertiärs, von Max Schlosser. I Theil. Alfred Hölder. Wien, 1887.

don. This obvious fact has, curiously, escaped the observation of all the numerous naturalists who have studied this group. As a consequence, he separates the eocene forms, which have all true canines in the lower jaw, as a distinct sub-order—the Pseudolemuridæ. Should this be really a sub-order, the name Mesodonta would have been the proper one to employ; but if a family only, then the term Adapidæ is applicable—which is, indeed, used by Dr. Schlosser in a restricted sense. Most of Dr. Schlosser's new material is derived from the French phosphorites.

We congratulate the author on the fact that no person can study this subject henceforth without the aid of this memoir.

LYDEKKER'S CATALOGUE OF FOSSIL MAMMALIA IN THE BRITISH MUSEUM, PART V.[1]—We have in this part of Dr. Lydekker's Catalogue a valuable contribution to the subject of which it treats. The light thrown on questions of affinity and taxonomic usage is considerable, and supplements from a conservative stand-point the opposite tendencies of Dr. Schlosser. Our own view of the case leads us to adopt in most cases the *aurea mediocritas* between these two distinguished cultivators of the science. There is one point, however, in which we are compelled to agree with Schlosser and not with Lydekker, and this in a question of scientific purism of which the latter is in all other cases so able a defender. This is in the matter of requiring a description,—whether good or bad matters not as to the rule,—for a genus and other division above species, as an essential basis for a nomenclature. *E. g.*, in the "Catalogue" we find the name Platychœrops used instead of Miolophus, although no reason for the separation of the former was ever given by its describer. Perhaps no description was given to Miolophus either. In that case Dr. Lydekker has the right to select whichever name he prefers, or to give a new one. One other point. On page 161, under the genus *Nototherium* Owen, we read, "Since this is the only known genus, its characters are the same as those of the family." Now, no one knows better than the author of this excellent series of works, that this cannot be the case!

Of course it is impossible for an author to keep pace with rapid additions to knowledge made in other countries. We only call attention here to the additional definitions of the Creodonta to be found in Professor Scott's late memoir on that order, and refer to my own later studies, now in press, on the fauna of the Puerco Epoch. But we object to the slight value attached by Dr. Lydekker to the presence or absence of the scapholunar bone in this order (p. 305). Finally, we rise to two questions

[1] Catalogue of Fossil Mammalia in the British Museum, Part V., containing Tillodontia, Sirenia, Cetacea, Edentata, Marsupialia, Monotremata, and Supplement. By Richard Lydekker, B.A., F.G.S., etc. London. 1887.

of privilege. The first point is found in a foot-note on page one, viz.: "Cope (*Vert. of the Tertiaries*, p. 195), who regards the outermost cutting-tooth as an incisor, states that it is absent in Tillotherium and present in Anchippodus, and that in the former there are seven and in the latter six cheek-teeth." This paragraph commits me to two errors of which I am not guilty. Let "outermost cutting-teeth" be changed into *innermost* cutting-teeth, and I am correctly quoted. As to the cheek-teeth, I state that my information as to Tillotherium is derived from Marsh, and as to Anchippodus I give the number with a question. The second point I wish to refer to is the assertion in a foot-note on page 379, that I state "that the inflection (of the mandibular angle) is absent in European forms" (of Peratherium). I here referred to the species called Oxygomphius by Von Meyer, some of which are true marsupials, but others are, according to Schlosser, Talpidæ. If there be an error, it is that of Von Meyer.—*E. D. Cope.*

Geological News—General.—The "American Geologist" sends forth its first issue in January, 1888. It announced that it is to be a non-partisan publication, open to the properly-worded opinions of all, from the most powerful to the most obscure, and "committed to no theory whether of construction or obstruction." Its editors and proprietors are Profs. S. Calvin, of Iowa University; E. W. Claypole, of Buchtel College; A. E. Hicks, of Nebraska State University; N. H. Winchell, of Minnesota University; Dr. Persifor Frazer, of Philadelphia; Dr. A. Winchell, of Michigan University; and Mr. L. O. Ulrich, of the Geological Survey of Illinois.

Prof. Claypole utters (*American Geologist*) a most distinct warning to those who, merely because the wish is father to the thought, believe the supply of natural gas to be inexhaustible. Natural gas, oil, and salt-water are geologically connected, and, where the strata are arched upwards, usually collect in the order named. After a certain part of the gas has been drawn off the oil will rise, and lastly the brine. Many once productive oil-wells are now little more than brine wells, though their age is but twenty years.

Gregorio Stefanescu, chief of the Geological Survey of Roumania, has issued a geological atlas of that country in fourteen colored sheets. Diluvial and alluvial strata are largely developed, but crystalline rocks occupy the northern portion bordering on Transylvania.

Silurian.—Messrs. U. P. and J. F. James publish in the *Journal* of the Cincinnati Society of Natural History a revision of

the species of the Monticuliporoid corals of the Hudson River group. They admit two genera, Monticulipora and Ceramopora, the former with the sub-genera Dekayia, Constellaria and Fistulipora.

DEVONIAN.—Prof. Calvin (*American Geologist*) describes *Streptindytes acervulariæ*, a new species and genus of tubicolar Annelida from strata of the Hamilton period, at Robert's Ferry, Iowa.

CARBONIFEROUS.—Dr. G. J. Hinde, in a paper read before the British Association at Manchester, brings evidence in support of the organic origin of the "chert" in the carboniferous limestone series of the British Isles. He believes that the Irish cherts at least are derived from the accumulation of the skeletal elements of the siliceous sponges.

JURASSIC.—Prof. H. G. Seeley has shown, by superimposing a figure of the reputed clavicle upon the bone figured by Mr. Hulke as clavicle and interclavicle of Iguanodon (*Quart Journ. Geol. Soc.*, vol. xli. pl. xiv.) that the supposed sutures are fractures, and that the supposed interclavicle has no existence, except as an ossification posterior to the reputed clavicles. Prof. Seeley urges the analogy of these bones with the reputed pubes of crocodiles, and concludes that they are pre-pelvic.

Prof. Seeley concludes, from examination of fœtal Plesiosauri found in a phosphatized nodule of Lias, that the Plesiosaurus was viviparous, and that the species in question, probably *P. homospondylus*, produced many young at a birth.

TERTIARY.—R. Lydekker (*Geol. Mag.*, July, 1887) states that all the so-called fossil Alligators of the Old World really belong to the genus Diplocynodon, and since the crocodiles (C. *palustris* and C. *sivalensis*) which approach nearest to this genus in the structure of the cranium and form of the maxillo-premaxillary suture on the palate are confined to India, it becomes interesting to know whether the existing alligator recently described from China, may not show signs of affinity with Diplocynodon.

Mr. Lydekker concludes that *Crocodilus champsoides* and C. *toliapicus*, from the London clay, are but the young and old individuals of a single species, for which the original name of C. *spenceri* Buckland, should be retained.

H. B. Geinitz identifies *Nautilus alabamensis* Morton, and *N. lingulatus* von Buch with *Nautilus ziczag* Sowerby, and places the form in the genus Aturia. The species is from the Tertiary of Alabama and Mississippi.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—As the result of a recent trip through the southern extremity of Africa, E. Cohen[2] has succeeded in giving us quite a good deal of information regarding the Palæozoic formations of the Cape States. The pre-Devonian schists of the coast region have been treated in another place.[3] In the present paper the author confines himself to the various members of the Devonian and Carboniferous systems, and other formations overlying these. The most widespread rocks in this region are sandstones, graywackes and conglomerates. The Karroo formation (Triassic) Cohen divides into a lower, a middle and an upper series. The lower series comprises fragmental rocks with an occasional intercalated layer of an eruptive. The middle series is characterized by the number of layers of eruptives intruded between those of sedimentary rocks as well as by the number of dykes cutting across the latter. The eruptives, with a single exception, are plagioclase augite rocks. By far the larger proportion of these belong to the diabase family, many of them being olivine bearing. In the latter the pœcilitic structure is frequently well marked. The diabases, quartz diabases, proterobase and diabase porphyrites, of both the intercalated layers and the dykes, are regarded by Cohen (as the result of careful analyses) as mere phases of the same magma. The single exception to the prevailing plagioclase-augite eruptives mentioned above is in the case of a dyke-cutting olivine diabase. The material of this bears a strong resemblance to mica syenite. At the points where the diabase layers come in contact with the interstratified sandstone beds the latter have been subjected to considerable alteration. The unaltered rock is an ochre-yellow, fine grained sandstone, made up of quartz and colorless mica, besides a little iron hydroxide and earthy material. As it approaches the diabase it gradually loses all traces of its bedding planes, and in it is developed a green chloritic mineral, whose nature was not determined. Nearer to the eruptive the chloritic mineral increases in quantity, and in addition there is a development of biotite and a disappearance of the earthy material, which has probably gone to make up the biotite. In immediate contact with the diabase the sandstone has been entirely changed to a typical black hornfels. In it all the constituents have taken on a concretionary form. Analyses of the unaltered sandstone and of two typical altered phases teach that the change in the nature of the sedimentary rock is not due to any addition of diabase material. The dyke rocks produce but little alteration in the neighboring fragmentals. In

[1] Edited by Dr. W. S. Bayley, Madison, Wisconsin.
[2] Neues Jahrb. f. Min., etc., 1887, Beil. Bd. v. p. 195.
[3] Ib., 1874, p. 460.

one case, however, where a dyke cut sandstone, it was noticed that biotite plates were developed parallel to the sedimentary planes of the sandstone, while muscovite formed perpendicular to these planes. The remainder of the paper is devoted to a discussion of the upper members of the Karroo formation and to the Pleistocene deposits.

Another interesting paper is by K. Dalmer,[1] on the quartz trachyte of Campiglia, in Tuscany. The glassy variety of this quartz trachyte is a fine-grained gray rock, consisting of a glassy groundmass in which are porphyritic crystals of sanidine, quartz, biotite and cordierite, with occasional crystals of plagioclase. The quartz grains all possess a rounded outline in cross section, and are surrounded by a zone of glass. In addition to the minerals mentioned above there also occur in this variety prismatic crystals of some member of the scapolite group light red garnets, apatite and zircon. In a felsitic variety scapolite is lacking. In the neighborhood of the quartz g rains the felsitic groundmass of the rock is replaced by a zone of glassy material. The cordierite is less fresh and it is in the glassy variety, and in many instances is entirely replaced by pinite. In a third variety, occurring in dykes, the groundmass is completely crystalline. These dykes of grano-porphyritic trachyte were regarded by Lotti[2] as quartz porphyries, and as apophyses of a so-called granite mass which occurs about fifteen hundred metres distant from them. This mass was likewise examined by Dalmer, who, while he finds it to possess the characteristics of a granite porphyry, believes that its present condition is due to the conditions under which it cooled, and that the three trachytes and the granite porphyry are all portions of the same magma, which, from the nature of its surroundings, gave rise to rocks which from their structure and mineralogical composition must be classified under different heads.

Professor C. R. Van Hise[3] communicates some additional[4] notes on the enlargement of hornblende and augite in fragmental and eruptive rocks. In the altered diabases of the Penokee-Gogebic Iron-Bearing Series crystals of uralitized augite are seen to have attached to them long acicular crystals of a very light green hornblende, which extend out from the uralite even into the surrounding decomposed feldspars. In other cases unaltered augite is surrounded by an almost continuous sheet of amphibole. In both cases the crystallographic axes of the two minerals coincide. Dr. G. H. Williams[5] describes the alteration of ilmenite into rutile, in altered diabase from the vicinity of Quinnesec, Mich. Irregularly-shaped pieces of ilmenite are surrounded by a network of little prismatic crystals of rutile.

[1] Neues Jahrb. f. Min., etc., 1887, ii., p. 206.
[2] Atti della Societa Toscana. Vol. vii.
[3] Amer. Jour. Sci., May, 1887, p. 385.
[4] American Naturalist, Dec. 1885, p. 1216.
[5] Neues Jahrb. f. Min., etc., 1887, ii., p. 263.

Alf. Gerhard[1] calls attention to the fact that most of the rocks described as soda-granites are really ordinary granites in which the proportion of sodium is little greater than is usually found in granites. The Ulfserud (Sweden) rock, however, appears really to contain a plagioclase approaching very near to albite in composition.

MINERALOGICAL NEWS.—*Dihydro-thenardite* is the name given by Markownikow[2] to a substance found in a thin colorless bed on the shore of Lake Gori, in the Gouvernement Tiflis, Russia. In composition it is a sodium sulphate differing from thenardite and mirabilite in appearance and its content of water. An analysis yielded 16.15 per cent. of water, corresponding to the formula $Na_2 SO_4 + 2 H_2 O$. It crystallizes in the monoclinic system.—Laist and Norton[1] report the occurrence of a *new antimonide* from near Mytilene, Asia Minor. The new mineral resembles silver in color and lustre. It is massive and brittle. Its hardness is 4.-5. and its specific gravity 8.812. Upon analysis it yielded: Cu = 73.37 per cent., Sb = 26.86 per cent., corresponding to $Cu_{11} Sb_2$ (breithauptite = Ni Sb, dyscrasite = $Ag_3 Sb - Ag_6 Sb$.)— A *Barium manganite* from near Austinville, Wythe county, Virginia, according to Mr. Walker,[3] is of the following composition:

$Mn O_2$	Mn O	Ba O	$H_2 O$	$Si O_2$	($Fe_2 O_3$. $Al_2 O_3$)
68.86	7.51	14.42	5.08	1.98	2.23

It is found imbedded in psilomelane and ferruginous clay in the form of "radiating fine fibrous needles." Its color is brownish-black. Hardness = 1.5. Sp. Gr. = 3.27. It differs from varvicite ($Mn_4 O_7 + H_2 O$) and lepidophæite ($Cu Mn_6 O_{12} + 9 H_2 O$) in containing Barium.[4] Its composition may be represented by the formula $Ba Mn_9 O_{18} + {}_2O + 3 H_2 O$. In a letter to the *Neues Jahrbuch für Mineralogie* Darapsky[5] communicates the results of some analyses of certain Chilian zeolites and of a natural *amalgam* to which he ascribes the formula $Ag_{39} Hg$.— A black opaque mineral, associated with the tourmaline of Hamburg, N. J., and DeKalb, N. Y., Mr. Diller[6] thinks may be a fourth form of titanic oxide.

ROSENBUSCH'S "MASSIGE GESTEINE."—The second portion of Professor Rosenbusch's *Massige Gesteine*[7] fully sustains the good impression produced by the first part.[8] This concluding portion of

[1] Ib., 1887, ii., p. 267.
[2] Jour. d. russ. phys.-chem. Gesells. 1887 [I], p. 252; Ref. Ber. d. deutsch. chem. Gesells., 1887, p. 546
[3] Amer. Chem. Jour., x., Jan. 1886, p. 60.
[4] Ib., p. 41.
[5] Neues Jahrb. f. Min., etc., 1888, i., p. 65.
[6] Amer. Jour. Sci., Jan. 1888, p. 51.
[7] Mikroskopische Physiographie der Massigen Gesteine, 2 Abt. Stuttgart, 1887.
[8] American Naturalist, Feb. 1887, p. 172.

the great handbook of petrography embraces in its treatment the effusive rocks, which are divided into the palæovolcanic and the neovolcanic classes. Under the former are included the quartz-porphyries, the quartz-free porphyries and keratophyres, the porphyrites, the augite-porphyrites and melaphyres, and the picrite-porphyrites. We miss here the elæolite porphyrites, which have been relegated to the questionable group of dyke rocks, and the quartz-porphyrites, which have been merged into the porphyrite family. The melaphyres are now members of the augite-porphyrite family, and the keratophyres have found a home among the quartz-free porphyries. There are nowhere as sharp distinctions made between rocks of different mineralogical and chemical compositions as were found in the first edition of the *Massige Gesteine.* The classification has become somewhat more complicated than the old one, but at the same time it seems more reasonable in the light of recent investigations. Among the neovolcanic rocks we find the liparites and pantellerites, the trachytes and quartz-free pantellerites, the phonolites, the dacites, the andesites, the basalts, the tephrites and basanites, the leucite rocks, the nepheline rocks, the melilite rocks and the limburgites and augitites. We here also miss a few familiar groups. The augite andesites are classed with the andesites. The tephrites and basanites have been united into one family. The entire group of glassy rocks has been eliminated, and the individual members have been included among those families of the neovolcanic rocks with which they are genetically connected. The discovery of a triclinic potassium sodium feldspar by Förstner[1] in the sodium-rich liparites of the island Pantelleria has resulted in the separation of the old liparite family into two subfamilies—the liparites proper, containing sanidine, and the pantellerites containing anorthoclase as their principal feldspathic constituents. Each family among both the palæovolcanic and the neovolcanic effusives is composed of numerous species or varieties, each one of which is characterized by definite properties, as structure, composition, etc., which distinguish it from other members of the same family. But it would require too much space even to mention here the numerous members of the effusive rocks, and would serve but little purpose. The petrographer must study the *Massige Gesteine* if he would keep abreast of his science, and to no others would a detailed discussion of the many new suggestions contained in the book be interesting.

[1] Zeits. f. Kryst., 1877, i., p. 547, and 1883, viii., p. 125.

BOTANY.[1]

The Grass Flora of the Nebraska Plains.—The plains of Nebraska were originally covered in great part with various small grasses to which the common name of "Buffalo grass" was applied. The true Buffalo grass (*Buchloë dactyloides* Engelm.) formerly extended eastward to or nearly to the Missouri River, but now it is rare east of the 100th meridian. On the curious depression near the city of Lincoln, to which the general name of "Salt Marsh" has been given (although it is in no sense a marsh), small patches of Buffalo grass may still be found. It is a peculiar grass, and when one has once noticed a patch of it, he will at once be able to recognize it even at a distance. It invariably grows in patches, and in each patch scarcely anything else grows. It does not intermingle with other species but holds complete possession of the soil, forming a dense mat which chokes out all opposition.

Northwestward, up the Elkhorn Valley, Buffalo grass does not appear in any quantity until very nearly the 100th meridian is reached, although much of the land is still uncultivated. Going westward from Lincoln, small patches are to be seen in Clay county (98th meridian), and from this point it increases as one goes up the plain above the 2,000 ft. line. In the Loup valley, however, Buffalo grass is not abundant, while in the Republican it is very common. In the western portion of the State, from the Lodge Pole Creek on the south to the White River country on the north, it is still very abundant.

Gramma (*Bouteloua oligostachya* Torr.) is still found throughout the State, although it is by no means abundant in the eastern two-thirds. It is often called Buffalo grass, and from it a short hay is sometimes cut in the latter part of summer. Its relative, the Muskit or Mesquite grass (*Bouteloua racemosa* Lag.), has a still wider distribution, extending eastward into Iowa and Illinois, and westward across the plains.

In the far-west, above the altitude of 3,500 feet above the level of the sea, another of the grasses of the plains proper appears. It resembles Buffalo grass so closely in general appearance, that it may well bear the name of False Buffalo grass (*Munroa squarrosa* Torr.), although it belongs to an entirely distinct genus.

Upon the saline and alkaline soils Salt grass (*Distichlis maritima* Raf.) grows in abundance. I have seen it upon all parts of the great Nebraska plain.

The grasses which are most noticeable in nearly all portions of this region are the Blue Stems or, as they are sometimes called, the Blue Joints. The great *Andropogon provincialis* Lam. and its smaller relative *Andropogon scoparius* Michx. occur in company with *Chrysopogon nutans* Benth., the latter often called Bushy Blue

[1] Edited by Prof. Chas. E. Bessey, Lincoln, Neb.

Stem. Throughout all parts of the State they occur in company, and they are common and abundant in nearly every locality. However, in the eastern part of the region they grow taller, and are more inclined to entirely cover the ground. The first-named often attains a height of from six to eight feet. In the western part of the region *Andropogon saccharoides* Swz., a feathery topped species, occurs along with the preceding.

In the eastern counties Wheat grass (*Agropyrum glaucum* R. & S.) appears in little patches, which are plainly noticeable on account of their glaucous green color. As every botanist knows, this species bears a remarkable resemblance to Quack grass (*Agropyrum repens* Beauv.), but it is not as much inclined to spread by its underground rootstocks as its eastern relative. As we go westward this Wheat grass increases in abundance, and by the time we reach the altitude of 3,000 to 5,000 feet, it is one of the most valuable of the hay grasses, and is relied upon very largely for forage by the farmers and stock growers.

Two other grasses are very common upon the plains, viz., *Eatonia obtusata* Gr. and *Koeleria cristata* Pers. They occur everywhere upon the drier lands, and are emphatically Prairie grasses. With them we find very commonly *Sporobolus asper* Kth., a late-growing species, which remains standing all winter long, with leaves wrapped around its partly enclosed fruiting panicle.—*Charles E. Bessey.*

SOLMS-LAUBACH'S PALÆOPHYTOLOGIE.—A few months ago this important work was brought out by Arthur Felix in Leipzig. Its scope may be indicated by the following summary of its contents: Thallophytes and Bryophytes receive 19 pages; Coniferæ, 33; Cycadeæ medulloseæ, 20; Cordaiteæ, 19; Ferns, 53; Lepidodendreæ, 48; Sigillarieæ, 23; Stigmaria, 32; Calamarieæ, 50; Sphenophylleæ, 13. Fifty or more pages are devoted to smaller groups, and to the discussion of genera of doubtful affinity. Forty-nine wood-cuts add materially to the value of the volume.

BOTANICAL WORK IN NEW YORK.—The reception of two reports from the State botanist enables us to note the progress of systematic botany in New York. The statement of the work of the botanist for 1885, published in the Thirty-ninth Annual Report of the New York Museum of Natural History, 1886, includes descriptions of many new species of fungi, among which are seven species of Agaricus, one of Russula, two of Boletus. The New York species of the genera Pleurotus, Claudopus and Crepidotus are fully described.

In the Bulletin of the New York State Museum of Natural History, Vol. I., No. 2, which bears date of May, 1887, Mr. Peck describes fifty-four species of fungi, among which is an interesting

Morchella (*M. angusticeps*), which is apparently related to *M. conica* Pers. Descriptions of the New York species of the genera Paxillus, Cantharellus and Craterellus follow in the usual lucid style of the author. Measurements are give (unfortunately in fractions of an inch), and good notes as to habits and habitats.

The New York Pyrenomycetous fungi are listed according to Saccardo's nomenclature, and for convenience the former names are given in a parallel column. The Bulletin closes with a monograph of the New York species of Viscid Boleti. Fourteen species are carefully described, two of which (*B. subluteus* and *B. americanus*) are new to science. Two good plates accompany the Bulletin.—*Charles E. Bessey.*

THE DEATH OF DR. ASA GRAY.—On the 30th of January, Dr. Asa Gray, the venerable botanist, passed away, after an illness of two months. He was born in Oneida county, N. Y., November 18, 1810, and was consequently a little more than 77 years old when he died. Although spared to such an advanced age, with undiminished mental and bodily vigor, which enabled him to continue work into his 78th year, yet all the world of science will mourn his death, regretting that so great and kind a master should be taken away. A longer notice will appear later.

BOTANICAL NEWS.—The November-December number of *Hedwigia* contains a heliotype of the lamented Georg Winter, with a sketch of his life and labors. Dr. C. Sanio now assumes editorial control of *Hedwigia.*——The second number of *Annals of Botany* contains papers as follows, viz.: On Hydrothrix, a new genus of Pontederiaceæ, by Sir J. D. Hooker; On the obliteration of the Sieve-tubes in Laminariæ, by F. W. Oliver; Some words on the life-history of Lycopods, by Melchior Treub; On the modes of climbing in the genus Calamus, by F. O. Bower; On the limits of the use of the terms Caulome and Phyllome, by F. O. Bower; On the absorption of Water, and its relation to the constitution of the cell-wall, by J. R. Vaizey; On the use of certain plants as Alexipharmics, or Snake-bite Antidotes, by D. Morris; Notes on the genus Taphrina, by Benjamin L. Robinson. In addition there are several short notes, and a couple of book notices.——In the January *Journal of Botany*, James Britten takes up Professor E. L. Greene's discovery as to the nomenclature of Nymphæa (*Bull. Torr. Bot. Club*, Sept., 1887), and, after full discussion, makes out that hereafter our Nymphæaceæ must bear the following names: *Nymphæa advena* [Soland] Ait. (= *Nuphar advena* Ait.); *Nymphæa lutea* Linn. (= *Nuphar lutea* Smith.); *Nymphæa sagittifolia* Walt. (= *Nuphar sagittifolia* Pursh.); *Castalia pudica* Salisb. (= *Nymphæa odorata* Ait.) In other words, our Nuphars are hereafter to

be Nymphæas, and our Nymphæas hitherto are hereafter to be known as Castalias.——In the January *Gardener's Monthly* the suggestion is made that certain species of Cactus may become of value as fodder plants for domestic animals.——The January *Torrey Bulletin* contains Studies in Typhaceæ, by Thomas Morong; New and Little-known Grasses, by F. L. Scribner, and New Western Grasses, by George Vasey, besides other articles of interest. Professor James suggests the name Anthophyta for Phanerogamia —a very good name too.——The January *Botanical Gazette* contains a portrait of Dr. W. Pfeffer, of the Botanical Institute at Tübingen, with a sketch of the institute, illustrated with a plan and views. The index to Vol. XII., which accompanies this number, is a model among indexes. Certainly no reader of the last year's volume of the *Gazette* can complain, in Carlylean phrase, of its "indexlessness."

ZOOLOGY.

FUNCTIONS OF INVERTEBRATE OTOCYSTS.—Professor Yves Delage has been performing some experiments with a view of ascertaining the functions of the so-called ears of invertebrates. His results (*Archives de Zool. gén. et Expérim.* v. 1886) go to show that besides auditory capacities, they possess regulative faculties. When the octocysts were destroyed, the animal could not regulate its movements. This he shows is not due to the injury to the nerve, because the extirpation of the eyes did not produce disorder in the movements. His experiments were mostly upon Crustacea and Cephalopods.

PARASITIC ROTIFERS.—The marine rotifers which are parasitic upon the curious Crustacean, Nebalia, are grouped in a family Seisonidæ and the species of these found in the Bay of Naples have recently been studied by Dr. L. Plate. He adds to the two genera before included (Seison and Saccobdella) a third, Paraseison, with four new species. In these the trochal discs have been reduced and may be represented by a few sensory setæ; the intestine terminates cæcally in either six; the reproductive glands are at the sides of or above the intestine; the tail has no sucking disk, but on the rounded extremity open the glands which serve to attach the ectoparasite to its host. The paper may be found in vol. vii. of the Naples *Mittheilungen.*

MEDITERRANEAN SYNAPTIDÆ.—Dr. R. Simon contributes to the Naples *Mittheilungen* (vii. p. 272, 1887) an account of the Mediterranean Synaptidæ, embracing the species *Synapta digitata,*

inhærens and *hispida*. These forms live on, not in the sand, in this not resembling our American *S. girardi*. There are some detailed accounts of the development of the calcareous plates of these as well as other Echinoderms. The author also describes a new species .of Chirodota (*C. venusta*), the first recorded from the Mediterranean.

BEDDARD ON EARTHWORMS.—The literature of the Lumbricidæ is rapidly assuming frightful proportions, so that none but the specialist can keep track of it. Mr. F. E. Beddard has recently added much to our knowledge of these forms. In the *Proceedings of the Zoological Society* (p. 154, 1887), he describes as new *Thamnodrilus gulielmi* from British Guiana. This genus resembles Anteus by the absence of dorsal pores, in having a single pair of spermathecæ in the seventh segment, and in position of the nephridial opening. In Thamnodrilus, however, the clitellum is much shorter, and the differentiation of the nephridia into three series is another character separating them. Later in the same volume (p. 544), he describes *Cryptodrilus fletcheri* (n.sp.) from Queensland. It possesses calciferous glands and in its nephridia it is much like *Microchæta* but their orifices vary in position from segment to segment. The seminal vescicles occur in segments 9 and 12, but not in the intermediate segments. A third paper (*Jour. Anat.* and *Physiol.* xxii, October, 1887) deals with the structure of the ovum in *Eudrilus sylvicola* from British Guiana. Here the ovary is enclosed with muscular walls, the muscles being continuous with those of the oviduct, and its interior is divided by trabeculæ into separate compartments, which are packed with ova and germinal cells. The history of these is traced, the most noticeable feature being the metamorphosis of some of the germinal cells to form an epithelial cap on one end of the ovum, while others degenerate and form a fibrous looking, and more or less fluid mass around the ovum. This degeneration may have nutritive functions, but Mr. Beddard suggests its analogy to the liquor folliculi of the mammalian ovary, a view which receives some support from the fact that the most nearly ripe ova are not always found nearest the entrance to the oviduct.

ZOOLOGICAL NOTES. — PROTOZOA.—Mr. H. B. Brady catalogues the recent species of Foraminifera, occurring in Great Britain in the December number of the *Journal of the Royal Microscopical Society*. The classification adopted is the same as that used in the Reports of the Voyage of the "Challenger." 267 species are enumerated, but one (*Trochammina robertsoni*) being regarded as new. The genus Haliphysema is regarded as a Foraminifera.

Dr. A. C. Stokes has recently described some more American Infusoria. In the *American Mon. Micros. Jour.* (p 141) he adds

to our fauna *Anthophysa stagnatilis Hexamita gyrans Chloromonas, Balanitizoon gyrans, Gerda vernalis Rhabdostyla vernalis, R. chæticola, Vorticella similis, V. vernalis, V. parasita, V. conica, Epistylis tincta,* and *Lagenophrys obovata.* In the Annals and Magazine of Natural History for August, 1887, he adds: *Onychodromopsis flexilis* (n. g. et sp.) *Tachysoma agile* (n. g. et sp.) *T. mirabile, T. parvistylum, Litonotus vermicularis, Loxodis magnus, Oxytricha biforia, O. hymenostoma, O. acuminata, O. caudata, Histrio inquietus, H. complanatus, Euplotes variabilis,* and *Chilodon vorax.* The last species feeds voraciously upon diatoms, some of which were actually longer than the infusorian.

Podarcella is the name given by Girard to a stalked Rhizopod allied to Arcella which occurs in the sea near Fécamp. The stalk is about one and one-half times as long as the lorica.

WORMS.—The veteran, P. H. Gosse, describes twenty-four new British rotifers in the December number of the *Journal of the Royal Microscopical Society.* The specimens were from both fresh and salt water.

Those interested will find a valuable article on the anatomy and histology of the Aphroditaceæ, by Dr. E. Rhode, in the second volume of Schneider's *Zoologische Beiträge,* and one on the anatomy and histology of Eunice, by E. Jourdan, in the second volume (seventh series) of the *Annales des Sciences Naturelles.* Jourdan thinks he has founed the terminations of the nerves in the muscles; does not regard the "giant nerve fibre" of the ventral cord as nervous but rather as a supporting structure; describes the eye, found no glandular structures in the digestive tract, and describes the segmental organs, pedal glands, and pigment organs.

CRUSTACEA.—It is usually believed that hermit-crabs appropriate dead shells for their homes but Mr. Lucas, in the *Transactions* of the Royal Society of Victoria, states that he witnessed a hermit attack a living Fasciolaria and little by little tear it in pieces, leaving the shell at last entirely empty. He also recalls the fact that, at least in tropical waters, the shells occupied by hermit-crabs have a fresh appearance, and he thinks that the crabs depend upon living shells rather than dead ones to form their homes. This certainly is not the case with the hermit-crabs in the colder Atlantic.

Leichmann has settled by means of sections the existence of two polar globules in the egg of *Asellus aquaticus.* His short paper may be found in number 263 of the *Zoologisches Anzeiger.*

The complete account of J. Nusbaum's investigations on the embryology of the opossum shrimp (Mysis) may be found in Lacaze Duthier's *Archiv. Zool. Expérim.* et *Générale*, vol. v. An abstract of his preliminary note was given in our pages last year (AM. NAT. xxi. p.).

ENTOMOLOGY.[1]

THE CAUSE OF THE GROWTH OF GALLS.—Herr M. W. Beyerinck has published a paper regarding the growth of the gall produced by a saw-fly, *Nematus capreæ*, on *Salix amygdalina*.[2] This article appears to be an important supplement to the observations of Adler, published some years ago. I have not seen the original paper by Beyerinck, and therefore quote from an abstract of it.[3]

"The production of the gall is undoubtedly due to the matter secreted by the poison-gland, which is, consequently, homologous with the poison of Hymenoptera aculeata; when the insect does not deposit an egg in the wound which it makes, the quantity of albuminous matter poured out by the vesicle is always less than when an egg is deposited; by careful observation it is possible to assure oneself that the size of the gall is always proportional to the size of the wound and the quantity of albuminoid matter introduced. By an experiment, in which the deposited egg was punctured by a fine needle, it was shown that the gall is due to the parent and not to the egg; but, of course, in such a case the gall remains small; neither the egg nor the larva are necessary for its production, though their presence exercises a certain influence on the regularity of the development."

"The author has endeavored to discover whether there is any persistent alteration in the protoplasm of the plant or not. If we suppose that the substance implicated in the substance of the gall is like the protoplasm of the plant, a living body able to grow indefinitely, or a substance which impresses a persistent modification on the protoplasm of the plant, we ought, if we should succeed in pushing the development of the gall as one of its parts beyond the stage at which it ordinarily stops, to find that the characters of the gall remain invariably the same. If, on the other hand, the gall-forming matter can not either grow itself nor form a new protoplasm capable of reproduction, we ought, under similar circumstances, to find the characters of the organ, whence the gall was developed,

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Arch. Néerland. Sci. Exact. et Nat., XXI. (1887), pp. 475-92.

[3] Jour. Roy. Micr. Soc., 1887, p. 746

reappear. Experience has shown that the second is the condition which it obtains; a normal leaf modified by the gall-forming material grew into a normal leaf, and a root into a root.

"The galls of *Nematus* are possessed of extraordinary vitality; those of *N. capreæ* are found living long after the leaf is dead; *N. viminalis*, which is found on *Salix purpurea*, exhibits really remarkable properties; although abandoned by their inhabitants at the beginning of autumn and being surrounded by damp mould during the winter, they not only remain perfectly turgescent, but some of them are able, in the following summer, to begin a new life. Galls cannot be inherited. The specific material secreted by *Nematus capreæ*—and what is true of it is probably true of other forms—is an albuminoid substance which acts as an enzymatic body."

Homologues of Arachnid Appendages.[1]—Herr A. Lendl has studied the development of *Epeira diademata* with reference to the much-discussed problem of the homologies of the appendages. The general conclusions of his investigations are as follows: (a) The first pair of appendages represent antennæ; this is suggested by their origin, position, motion, jointing, and innervation from the supra-œsophageal ganglion. (b) The small tubercles under the upper lip resemble mandibles in their origin and in the connection of their ganglia with the œsophageal ring. They appear more like mandibles in the embryo than in the adult. (c) The homology of the next pair (maxillæ) is evident. (d) The prosternum is no lower lip, but a portion of the sternum supporting the mandibles. No lower lip is discoverable; but the first of the four pairs of legs represent the second pair of maxillæ in insects.—Jour. Roy. Micr. Soc., 1887, p. 747. Herr Wendl, however, does not seem to have improved matters, for all studies of the development of the Arachnid appendages go to show that the first pair cannot be homologous with the hexapod antennæ. The latter are primitively prestomial, the former post-oral.—*J. S. Kingsley.*

Synopsis of the Aphididæ of Minnesota.—Bulletin No. 4 of the Geographical and Natural History Survey of Minnesota is a synopsis of the Aphididæ of that State, by Professor O. W. Oestlund, of the University of Minnesota. In this synopsis there is included a careful account of all the species of plant-life found in that State, together with notes on their habits. Many new species are described, and one new genus. The American species not yet found in Minnesota are indicated; and there is given a " List of North American plants with the species of Aphides known to attack them."

An Unpublished Illustrated Work on North American Lepidoptera.—Dr. Hagen calls attention[2] to "An unknown or for-

[1] Math. v. Naturw. Ber. aus Ungarn, IV. (1886), pp. 95-100.
[2] Entomologica Americana, vol. III, p. 173.

gotten illustration of North American Sphingidæ," a copy of which was presented to Harvard College by Mr. Wm. Calverley, of Barnegat, N. J., in October, 1887. The work consists of twenty-seven quarto plates of figures of Sphingidæ, and one of *Papilio calverleyi.* Dr. Hagen gives a careful description of the work, with a table of contents of the plates. As a copy was also given by Mr. Calverley to the Library of Cornell University, I am able to add a few facts of interest.

The lettering on the plates was done by hand. This accounts for a difference between the Harvard copy, as described by Hagen, and the one before me. In the former the names of the species figured on plate XV. are not indicated; in the Cornell copy they are given as follows: I. *Enyo camertus,* female; II. *Sphynx paphus,* male; III. *Macrosila hasdrubal,* female; IV. *Anceryx scyron,* female; V. *Calliomma lycastus,* female. In the Cornell copy all the plates are colored except plates XXII., XXIII. and XXIV. The plate illustrating *Papilio calverleyi* does not properly belong with the others; it is the same figure that was given with the original description of the species.[1]

The following statements are taken from a letter written by Mr. W. H. Edwards, Oct. 14, 1885, in reply to inquiries from the Cornell Library: "The work was never finished and never published. I gave away two or three copies of plain plates myself to friends; but have all the rest of my share here now. John W. Weidemeyer lived at Montclair, N. J., and did business in Cliff Street, New York. Stephen Calverley lived in Brooklyn. These two began the printing of plates of Sphinges. I joined them at second plate. I think twenty-eight plates were done; all drawn by Charles Waldo. Two plates were done in London, under supervision of the late Francis Walker, of the British Museum. I think four hundred copies were struck off. Weidemeyer intended to write text for these plates, but never did; and the work rested, and was never resumed."

EMBRYOLOGY.[2]

Hertwig's[3] Text-Book of Human and Vertebrate Embryology.—This very valuable hand-book of vertebrate embryology has just been completed by the publication of the second part, and, to those who know German, it will be a most welcome contribution to this very important subject.

Dr. Hertwig's little treatise is published in a convenient form, in

[1] Proc. Ent. Soc. Phila., 1864, pl. X.

[2] Edited by Prof. Jno. A. Ryder, Philadelphia.

[3] Lehrbuch der Entwickelungsgeschichte des Menschen und der Wirbelthiere. Von Dr. Oscar Hertwig. Octavo, pp. viii, 507. Gustav Fischer, Jena, 1887–1888.

large type, and with illustrations, which leave little to be desired. While the purpose of the work is the same as that of Kölliker's *Grundriss*, viz., for medical students, it presents certain admirable features not met with in the just-named classical and beautiful work of the venerable savant who holds the chair of anatomy in the University of Würzburg. The wonderful and accurate figures which adorn the pages of Kölliker's writings on embryology are no less attractive than the luminous style in which his expositions are couched. But in the *Grundriss* only two types are appealed to—viz., the Bird and Mammal, in order to unravel the intricacies of embryology as applied to the needs of the medical man.

With larger opportunities for study, and as the author of many classical contributions to the embryology of the lower types as well as through studies upon the maturation and fertilization of the egg in various types, Dr. Hertwig approaches his subject equipped with a range and profundity of knowledge not surpassed by any recent writer. His studies in experimental embryology—during which he, in association with his no less distinguished brother, Richard Hertwig, reached results of the most startling significance in causing multiple impregnation of a single ovum by previous immersion in dilute solutions of narcotics or anæsthetics—are still fresh in the minds of specialists. His no less interesting studies upon the phenomena of fertilization of the egg in echinoderms entitle him to rank amongst those pioneers of modern embryology who have given us a basis for a rational theory of heredity, founded, not upon abstract speculations, but upon carefully observed facts.

Through the observation of these facts by Hertwig and others it has been possible also to enunciate the doctrine of the continuity of germinal plasma and the laws of geotropy of the ovum; while his Cœlom theory, published in 1881, has already borne fruit in the admirable English treatise of Professor Haddon, which was noticed about a year since in this journal. This cœlom theory supplements that of the now universally accepted gastrula, and makes it possible to present the facts of embryology in such a manner as to render their comprehension easy and significant. While the protective coverings of ova—*i.e.*, the primary and secondary investments of the eggs of various types—have not been as fully discussed as they might have been, and the existence of a third or tertiary system of deciduous investments, derived from the segmenting ovum itself in the higher forms, has not been perhaps clearly recognized, on the whole the work commends itself as the most satisfactory manual which has yet appeared for those who have not the time to enter upon a special course of study in this branch of scientific discipline.

The author has succeeded, in the compass of two hundred pages, subdivided into thirteen chapters, in presenting in a novel and interesting manner what it is essential that the young naturalist or medical student should know of the sexual elements; the matura-

tion of the egg and the process of fertilization; the process of cleavage; the general principles of development; the development of the two primary germinal layers (Gastræa theory); the development of the middle layer (Cœlom theory); the history of the doctrine of germinal layers; the somites or segments; the blood and connective tissues (Mesenchyme theory); shaping of the external form; egg-envelopes of reptiles, birds, mammals and man. Each of the first thirteen chapters is epitomized at its conclusion in such a manner and in such logical sequence that these epitomes together form, perhaps, the most convenient synopsis of the present status of the principles of embryology.

The remaining three hundred pages of the book deal with organogeny, or the formation of the organs from the epiblast, hypoblast, mesoblast and mesenchyme. This portion is divided into four chapters, and in this respect differs in its method pretty widely from that followed by Haddon, who in his treatise includes a large group of structures, viz., lymphatic, blood-vascular and connective tissues under the subdivision of mesoblast. These are specially dealt with by Dr. Hertwig in a chapter on the mesenchyme.

The great advantage of this last method will be recognized by teachers of histology, who are thus furnished a means of more readily impressing upon the minds of pupils the true relations of that group of tissues and organs which form the intermediary vascular bonds and supporting structures for all the other organs. The genesis of the organs from the other primary layers is admirably illustrated with special reference to its bearings upon the anatomy of the adult human body, and is accomplished in a very satisfactory way, while enough data from comparative embryology are laid under contribution to give the reader a fair knowledge cf the wide application of the principles laid down.

The chapter on the principles of development in the first part of the book and the concluding résumés of the last four chapters are admirable; and while it is probably premature to form an opinion as to the exact method of the origin of the segmental ducts, the conservative position of the author is probably to be commended. In this connection, further studies upon the germ-bands of the leeches and earthworms, upon which such remarkable results have been published by C. O. Whitman and E. B. Wilson, will probably give us important additional light.

The manual of Dr. Hertwig will doubtless fill a long-felt want; and it is to be hoped that it will be made accessible to the English-reading student through a translation by some capable person. As an aid in understanding many questions in pathology, physiology, the structure of the brain and mechanism of the nervous system, this little work will undoubtedly be found to be of great value in lightening the burden of the overtaxed medical student in his

efforts to master the intricacies of the anatomy and histology of the adult human body.—*J. A. Ryder.*

Mr. O. P. Hay's Observations on the Breeding-Habits of Amphiuma.—In the last number of this journal (page 95) an interesting account was given of how the *Amphiuma* coils herself about her eggs. The description of the eggs and embryos is so strikingly like that of *Ichthyophis glutinosus*, a limbless, worm-like salamander,—the development of which has been worked out by the Sarasin Brothers from material collected in Ceylon,—that it is very important to call attention to this resemblance and its probable significance.

Within about two years Professor Cope called attention to the fact that the structure of the skull of the Cæcilians and of *Amphiuma* showed that these two forms were related. It now turns out that the females of these two types have the same habit of coiling themselves about their ova, which in both cases are laid in strings, with constrictions separating them, somewhat like a string of beads, the individul ova in both being also of about the same size. This confirmation of Professor Cope's conclusions as to the taxonomic relations of these two types is a very interesting instance of the way in which embryological data may become available. It may also be noted that in some of the Cæcilians there are three plumose or feathered branchiæ arising close together, and evidently similar to those described by Mr. Hay in the young of *Amphiuma*.

It is to be hoped that that gentleman will be good enough to somewhere publish carefully-drawn figures of the egg-strings of *Amphiuma*, as well as of the embryos.—*J. A. Ryder.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

The Anthropological Society of Washington has renewed and enlarged its sphere of usefulness. It has taken a new departure, in fact three new departures. It has elected a new president; it has become an incorporated society, and it has commenced the publication of a quarterly journal under the direction of an editorial committee. The name is *American Anthropologist*, the first number appearing January, 1888. The typography is in the highest order of the art. The article on the Chane-abal (four-language) tribe and dialect of Chiapas, by Dr. Brinton, Professor in the University of Pennsylvania, being done as to excite the admiration of all interested in the typographic art. The contents of the first number, in addition to the article just mentioned, are "The Law

[1] This department is edited by Thomas Wilson, Smithsonian Institution, Washington, D. C.

of Malthus," by Dr. Welling; "The Development of Timekeeping in Greece and Rome," by F. A. Seeley; "Anthropological Notes on the Human Hand," by Dr. Frank Baker. A future number will contain an article "From Barbarism to Civilization," by Major Powell, Director of the U. S. Bureau of Ethnology, a continuation of his history of man from savagery to barbarism.

Among the papers read before the society, of great value, and which we hope to see published ere long, was the prayer of a Navajo shaman, by Dr. Washington Matthews, U. S. A.; a linguistic map of North America, by Mr. H. W. Henshaw, of the U. S. Bureau of Ethnology, in which the author showed the existence, the condition and the relationship of the various Indian languages and dialects in all North America. The discussion of the Nephrite question, by Profs. Clarke and Merrill, was also interesting and valuable.

The New York Academy of Anthropology proposes to organize an International Congress of Anthropology in that city June 4–7; the project is a vast one, and, to be successful, will require the harmonious and energetic efforts of the anthropologists of the United States. The project is new in this country, but not in Europe. Anthropologic congresses have been there held for many years, and have been productive of much good in fixing a basis for the science and in harmonizing discordant opinions. Their importance has increased with each meeting, as has the number and intelligence of the attendants. The importance of one of these congresses held in the United States can scarcely be over-estimated. To make it a success and of practical value would require the co-operation of European anthropologists. Without it the proposed congress might be but slightly more important than the meetings of the section of anthropology in the Association for the Advancement of Science. If the co-operation and promise of attendance of the anthropologists of Europe has been secured, the success of the project is assured.

An attempt was made to hold such a congress at Athens, Greece, but it failed, owing to want of co-operation combined with the unsettled state of the country. But is not the time too short between now and June to correspond with the European anthropologists, distant and widely scattered as are their residences? Is it possible to secure their co-operation? Possibly it has already been done? They will take much interest in an international anthropological congress in America; many of them will gladly attend if the invitation is given within sufficient time, and they will feel grieved, and perhaps offended, at any arrangement which would leave them out.

The Centennial Celebration of the destruction of the Bastile takes place in the summer of next year (1889) in Paris. The Parisian

anthropologists will undoubtedly strive for the International Congress to be held in their city during that time. Their claim could be made with great show of right and would scarcely be ignored. It would be a source of regret if these two commendable projects should be made to interfere with, or nullify, the good that each might do.

CRIMINAL ANTHROPOLOGY.—The importance of the subject of Criminal Anthropology has not been properly appreciated in our country. I doubt if any branch of the social history of man can be studied with such practical benefit to the whole people.

Laws are still passed, and courts sit in its administration, as in olden time, the theory being to punish the criminal, not out of revenge, but for the prevention of crime. But in this principal object, the prevention of crime, the world has changed but little, and it is doubtful if it has improved any. There have surely been improvements in modern times in criminal jurisprudence, but they have been rather in matters of detail, pleading, practice, etc. Indictments are more simple and direct. The disqualifications of jurors are lessened, many matters of mere form have been brushed aside, all tending to the presentation of the truth to court and jury. The examination of the defendant as a witness is fast becoming a necessity. But with all this the science of criminal biology has received but slight attention from lawyers or law-makers. This, when done, must be done by anthropologists. The anthropologists of Europe are more interested in this work than are we of the United States. They have taken the initiative. An international convention met in Rome in the autumn of 1885, and devoted a week exclusively to criminal anthropology. In France the question of the *recidivists* presses hard upon the attention of the government. I saw a man stood up in the dock who had been then convicted of crime forty-two times. The Island of New Caledonia, in the South Pacific, serves as a prison for those who have been convicted of felony more than thrice. The Anthropological Society of Paris has taken up the subject and is now studying it seriously. By a law of France, all executed criminals, possibly only those of Paris, are delivered to this society, and in its Musee Broca are now to be seen all their articulated skeletons with a bit of cork filling the void made by the guillotine in the cervical vertebra. I feel that I can speak on this subject with more than ordinary authority. I have practised at the bar as a lawyer with reasonable success for twenty-five years, not so much, however, in the criminal branch. During my six years' consular life abroad there arose cases by which my attention was turned to the criminal system under the Code Napoleon. I was a member of the international congress for the reform and codification of the law of nations, and in my studies

of later years I have mixed, to a great extent, the sciences of law and anthropology, and I cannot too much exalt the investigation and study of criminal anthropology. But it should be practical as well as theoretical. The lawyer and legislator should be brought into communication with the anthropologist. Their co-operative labors would serve to elucidate the subject in a scientific as well as a practical manner, and would result in the lessening of crime and the general improvement of the body politic. A move in the right direction has been taken by the New York Academy of Anthropology at its meeting, January 3, 1888. The subject was divided into two sections, and the program of questions suggested for discussion was as follows:

CRIMINAL BIOLOGY.—1. What categories of criminals may we distinguish? and what are the fundamental characteristics, physical and psychical, which they display?

2. Is there a general bio-pathological constitution which predisposes its subject to the commission of crime? how does it originate, and what form does it assume?

3. What is the proper classification of human actions, based on the affections which give rise to them? What effect does the education of the moral nature have upon the passions, and, indirectly, upon crime?

4. Does the number of suicides stand in inverse ratio to the number of homicides?

5. Epilepsy and moral insanity in prisons and insane asylums.

6. Malingering among the insane.

7. The utility of a museum of criminal anthropology.

8. The influence of atmospheric and economic conditions of crime in America.

CRIMINAL SOCIOLOGY.—1. Should the theories of criminal anthropology be embodied in the revision of the penal code? and why?

2. The function of the medical expert in judicial procedure.

3. The best means for securing indemnity from crime.

4. The best means of combating relapses into crime (recidivism).

5. Crimes of a political character.

6. Ought students of criminal law to be admitted to penal establishments? and under what conditions?

The circular making the announcement, then continues:—

"We cannot too highly value the method of study of crime, which begins with the study of the criminal himself. It is impossible to evolve the criminal out of one's inner consciousness. Knowledge of his peculiarities is essential to any rational treatment of him, and this knowledge can only be gained by systematic, intelligent observation of his physical and mental habits, supple-

mented by an exhaustive analytical comparison of the facts observed, with a view to their right classification and interpretation."

Papers on the topics were to be read by Hon. A. C. Butts and Hon. Geo. H. Yeaman, of the New York Bar; Judge Calvin G. Pratt, of Supreme Court, Brooklyn, N. Y.; Foster L. Backus, Esq., of Brooklyn; Prof. J. J. Reese, of University of Pennsylvania; William J. Mann, Esq.; E. P. Thwing, M.D.; Prof. Moritz Benedict, of Vienna, and others.

The Bar Association of the District of Columbia has proposed an international or interstate law congress, to be held in the city of Washington, on the 22d of May, 1888, to which shall be invited representatives of all other bar associations, judges of courts, prosecuting officers, and lawyers whose eminence in their profession entitle them to that recognition. I do not know whether this will result in a permanent organization or not. But if so, I would suggest and strongly urge that it should have a section devoted to criminal anthropology; and that anthropologic societies and congresses should do the same. By this means professional lawyers who are amateurs of anthropology, and professional anthropologists who may be amateur lawyers, would have opportunities for the accomplishment of great good in their respective sciences.

MICROSCOPY.[1]

Gerlach's Embryoscope.[2]—The embryoscope, devised by Dr. Gerlach, supplies a great and long-felt desideratum in experimental embryology. It is a mechanism for closing hermetically, a circular opening, made with a trepan, in the shell of the hen's egg; and it serves the purpose of a window, through which the living embryo may be directly observed, and its development followed from day to day.

The instrument consists of two parts: 1. A *mounting-ring* (Aufsatzring) to be firmly cemented to the egg-shell. 2. A *key-piece* with glass front, which screws into the ring and closes it air-tight.

In the Cut. *A* represents the embryoscope in perspective, and *B*, in section. The metallic mounting-ring is 1¼ mm. thick, and has a lumen 2 cm. in diameter. The lower edge (*Ar*) is bevelled and saddle-shaped so as to fit the equatorial surface of the egg, while the upper edge is flat. From the outer surface of the ring, two square-cornered bars (*Z*) project in opposite directions. On its inner surface, a little above the lower edge, is a diaphragm (*Md*)

[1] Edited by C. O. Whitman, Milwaukee.

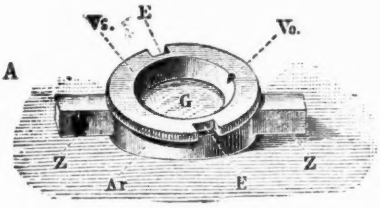
[2] Anatom. Anzeiger, II, Nos. 18 and 19, 1887, p. 583.

with an opening 13 mm. in diameter. Resting upon this diaphragm, and corresponding with it in size and shape, is a second diaphragm of thin wax-cloth (*Wd*), which serves as a packing-washer for the key-piece.

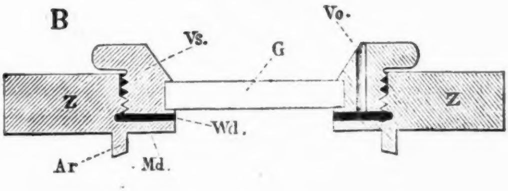
The key-piece of the embryoscope consists of a low, metallic cylinder, closed by a disk of glass (*G*), which represents the window that is to cover the artificial opening in the shell. The upper part of the cylinder expands peripherally to form a rim with a milled edge. This rim has two notches opposite each other, into which fit the arms of a small wrench, by the aid of which the key-piece can be tightly screwed down. There is also a short, narrow, vertical canal (Vo) or vent, the lower end of which must open in the middle of the key-piece ring.

The accessory apparatus required in the use of the embryoscope consists of (1) a *trepan*, (2) a *guide-ring* for the same, (3) a *metallic fork*, and (4) the *key or wrench* before mentioned.

A



B



The above-named pieces, together with a punch to cut wax-cloth diaphragms, and six embryoscopes, may be obtained from Reiniger, Gebbert, and Schall, Erlangen, for 36 marks, or from the Educational Supply Co., 6 Hamilton Place, Boston.

The trepan is a thin, metallic cylinder, 2 to $2\frac{1}{2}$ cm. long, the lower end of which is toothed, while the upper part is fluted and serves as the handle. The diameter of the trepan is a trifle smaller than that of the opening of the diaphragm. The object of this is to leave a very narrow zone of shell, covered with shellac, inside the inner edge of the diaphragm.

The guide-ring for the trepan has the same construction as the

key-piece, except that it has no glass disk. It serves to steady as well as guide the trepan during the process of cutting.

The fork has two notches at the ends of its prongs, fitted to receive the two bars of the mounting-ring. When adjusted to the bars, the fork serves as a means of holding the embryoscope securely, while screwing or unscrewing the key-piece.

The wrench, the use of which has already been explained, is similar in construction to the wrench used for mathematical instruments.

The mounting-ring is fastened to the egg by means of a cement consisting of *two parts of wax* and *three parts of colophonium.* The cement is hard and brittle at the ordinary room-temperature, but becomes soft and kneadable when held in the hand for a few moments. After warming the mounting-ring over a gas or a spirit lamp, a roll of the softened cement is pressed into the space which must be completely filled between the lower face of the diaphragm and the lower edge of the ring. As soon as the ring becomes sufficiently cool, it is pressed firmly to the equatorial surface of the egg, and the excess of the still soft cement, which is thus forced outward and inward beneath the ring, should be removed before it becomes brittle, by the aid of a small, sharp-pointed blade. In order to avoid injuring the blastoderm, which might occur if the hot ring were fastened to the shell directly over it, it is best to fix the ring to the *side* rather than the top of the egg.

After the ring has been securely fixed and the superfluous cement removed, the exposed edges of the remaining cement, seen beneath the lower edge of the ring and the inner edge of the diaphragm, must be covered with a coat of an alcoholic solution of yellow shellac. This may be applied with a small brush, care being taken to cover the cement completely, and as little of the egg-shell as possible.

After the shellac has dried, a process which is completed in twelve to fourteen hours in the open air and in six hours in the incubator, the shell may be trepanned.

Antiseptic precautions are required in opening the egg. An oblong porcelain trough or glass dish is first filled with a 3% solution of carbolic acid, and in this are placed the instruments to be used in the operation: a *glass rod*, a medium-sized *brush*, small *shears*, *forceps*, the *trepan*, and the *guide-ring.* Before using, these instruments are dried with carbolized cotton, and after using returned to the dish of carbolic acid.

After washing the hands in dilute sublimate or carbolic acid, a perfectly fresh egg is painted with the three per cent. solution of carbolic acid, and then dried with carbolized cotton. The small end of the egg-shell is then cut out with the shears, and the thick white poured with the aid of the glass rod into a clean dish, leaving the yolk and the thinner white in the shell. The white is to be

used in screwing in the key-piece, and must therefore always be prepared beforehand.

After these preparations, the egg to which the mounting-ring has been cemented is disinfected in the manner above described, and placed in an egg-carrier with the ring uppermost. The inside of the ring is then brushed with carbolic acid, which is shaken out after one or two minutes and replaced by a $\frac{1}{2}\%$ solution of common salt, which is also allowed to remain from one to two minutes, and then completely removed by means of carbolized cotton. The guide-ring is now screwed in, and the egg trepanned *from the side*, in order to avoid injuring the blastoderm. The egg is next placed with its opening upward, and the guide-ring removed. When the trepan is withdrawn, the excised piece of shell often comes with it, and sometimes the underlying shell-membrane. If this is not the case, the two pieces must be removed separately by the aid of the pincers. Care must, of course, be taken not to injure the blastoderm and the *zona pellucida*.

The thin white, which was left with the yolk in the shell, is allowed to flow over the glass rod upon the exposed blastoderm until the ring is filled, care being taken to avoid air bubbles. The wax-cloth diaphragm is next taken from the dish of carbolic acid, dried in blotting-paper, drawn through the thick white, and inserted in the ring in close contact with the metallic diaphragm; and then the key-piece, previously washed with carbolic acid and dried with carbolized cotton, is slowly screwed down. The superfluous white is thus slowly forced out through the vent (*Vo*), until the key-piece reaches the diaphragm and closes the vent. Finally, when the strength of the hand is no longer sufficient, the egg with its embryoscope is placed in the metallic fork, and the wrench applied until with this means it is no longer possible to turn the key-piece farther.

The process of trepanning and inserting the key-piece is somewhat more complicated in the case of eggs that have already been incubated, as the egg and the fluids employed must be kept warm. A water-bath is required, consisting of a low tin box, filled with water, and provided with covered apartments for the reception of the egg, the thin white, the carbolic acid, and the salt solution, which are in this way maintained at a proper temperature. In other respects, the mode of procedure is exactly the same as given above.

The key-piece may be removed as often as desired, provided the above precautions are taken each time in inserting it. If the key-piece is unscrewed by means of the fork and wrench, it must, of course, be washed in the warm carbolic acid, and the vent cleared by the introduction of a wire.

The egg must be placed in the incubator with the embryoscope

on one side. If it is placed upward, the respiration of the embryo is hindered. The embryoscope can be turned up at any moment, and kept upright for five minutes at a time without injury to the embryo.

With a little practice, the whole process of arming an egg with the embryoscope may be completed in from six to eight minutes.

The embryoscope is well adapted for purposes of class-demonstration, for investigating the growth of the various parts of the embryo, and the physiological processes during embryonic life, as the action of the heart, movements of the body, etc. It is indispensable to him who would study the effects of external agents upon the embryos of warm-blooded animals; and must be of great service where it is required to determine the precise stage of development before removing the embryo from the egg. It has been found useful in studying the formation of double embryos. Fenestrated eggs have been successfully incubated up to the thirteenth day, and it is probable that under favorable conditions the embryos of such eggs would reach maturity.

On the fifth day, it is still easy to bring the embryos under the window. On the sixth and seventh days, it is more difficult. At this period the change in the position of the embryo, which requires from five to ten minutes, should take place in the incubator.

After the eighth day, the embryo cannot be brought under the window. If it be necessary to determine whether such an egg or an older one still lives, we have only to leave the egg for several hours in the incubator with the window directed upwards a little, after which, by strong reflected light, one may readily see the blood circulating through the channels of the vascular area.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.—Sept. 20, 1887.—Mr. G. H. Parker gave an historical sketch of investigations upon the eyes of arthropods. Grenacher's theory of the hypodermal origin of the retina, developed by involution, has been borne out by later studies. From a study of the nerve distribution, the speaker believed the three-layered eye to be evolved from that with one layer.

Mr. Meehan stated that in Mesembryanthemum and similar plants, the glands of which develop in inverse proportion to the roots, chemical analysis sometimes determines the presence of more nitrogen than can be obtained from the soil. It was suggested that the glands absorbed the gas from the atmosphere.

Mr. H. T. Cresson exhibited specimens of prehistoric implements collected from beds surrounding what had probably been pile dwellings on the mud flats of the Delaware, near Naaman's Creek.

Professor Heilprin described the finding of the remains of a mastodon near Pemberton, N. J.

Oct. 18, 1887.—Dr. H. C. McCook gave an account of an American tarantula which must have been at least seven years old at death, and stated that a queen of the fuscous ant, in the possession of Sir J. Lubbock, died at the age of thirteen years.

Dr. Leidy described a collection of fossil bones from Archer, Fla., and characterized *Hippotherium plicatile*, from teeth and ankle bones, as a species of horse new to science.

Professor Ryder described a ring-like prolongation of the placenta in embryo mice and rats, as indicating the descent of these animals from lower types on which the placenta was zonary.

Oct. 25, 1887.—Professor J. A. Ryder stated his conviction that the organ in the head of fishes, supposed by Wiedersheim to be the homologue of the pineal gland, was really a portion of the lateral line system, and thus derived from the skin.

Mr. Woolman described the deposits pierced by an artesian well, 1,100 feet deep, at Atlantic City. Thirty-one species, including three sharks and a crocodile, were the fossil harvest.

Professor Heilprin stated that *Perna maxillata* found in the above well at a depth of about 800 feet, in dark clay, indicated the base of the miocene, while the Turritella found above indicated the middle miocene. The speaker and his class had recently collected several species new to the miocene fauna of New Jersey, including three new to science.

Dr. Kœnig described a new variety of unisilicate of manganese, and proposed for it the name "Bementite."

Dr. Leidy stated his belief, founded on examination of numerous examples, that the brown hydra of North America is identical with that of Europe; and Professor Ryder stated that the marine parasitic infusoria of the American coast were the same as those of Europe.

Dr. Cheston Morris described certain Dorsetshire sheep which seemed to be intermediate between the ordinary sheep and the goat.

Nov. 1, 1887.—Dr. H. C. McCook described the habits of *Formica rufa*, their mounds, their straight roads, etc. *Atta fervens*, a Texan ant, constructs straight underground trails, sometimes for a length of 448 feet.

Dr. Dolley spoke of the native cotton of Harbor Island, one of the Bahamas. It is of a reddish buff tint, and is not attacked by the cotton worm.

Professor Heilprin exhibited the mastodon remains found at Pemberton, N. J.

Nov. 15, 1887.—Professor Ryder described certain improvements in preparing tissues for the microscope. Soaking in celloidin and then in chloroform enabled the most fragile structures to be manipulated.

Nov. 22, 1887.—Dr. H. C. McCook described *Cyrtophora bifurca*, a new orb-weaving spider from Florida.

Dec. 6, 1887.—Mr. Meehan called attention to the prolific growth of interaxial tubers obtained from *Dioscorea eburnea*, a Chinese plant.

Dec. 13, 1887.—Mr. W. H. Dall mentioned the finding of the parasite *Leucochloridum paradoxum* in a Western species of Succinea.

Jan. 24, 1888.—Professor W. P. Wilson stated that the apparatus for catching and assimilating insect food is much more efficient in *Sarracenia variolaris* than in *C. purpurea.*

Dr. Horn exhibited a collection of May beetles, comprehending 79 out of the 81 species known north of Mexico.

Professor J. A. Ryder stated that the manner of cleavage of the yolk in the eggs of lampreys and Batrachia differs from that which obtains in osseous fishes, birds and reptiles.

Biological Society of Washington, 117th Regular Meeting.—Dec. 17, 1887.— The following communications were presented —Mr. C. L. Hopkins, "Notes Relative to the Sense of Smell in Buzzards;" Dr. Cooper Curtice, "The Timber Line of Pike's Peak;" Mr. Charles D. Walcott, exhibited a section of a fossil Endoceras over eight feet in length, with remarks on the same; Dr. Leonhard Stejneger, "On the Extinction of the Great Northern Sea Cow;" Dr. C. Hart Merriam, "Description of a New Mouse from the Great Plains."

118th Regular Meeting.— Dec. 31st, 1887.—The following communications were read:—Mr. W. J. McGee, "The Overlapping Habitats of *Sturnella magna,* and *S. neglecta* in Iowa;" Dr. C. Hart Merriam, "Description of a new Field Mouse from Western Dakota;" Mr. W. B. Barrows, "The Shape of the Bill in Snail-eating Birds;" Mr. H. Justin Roddy, "Feeding Habits of some Young Raptores."